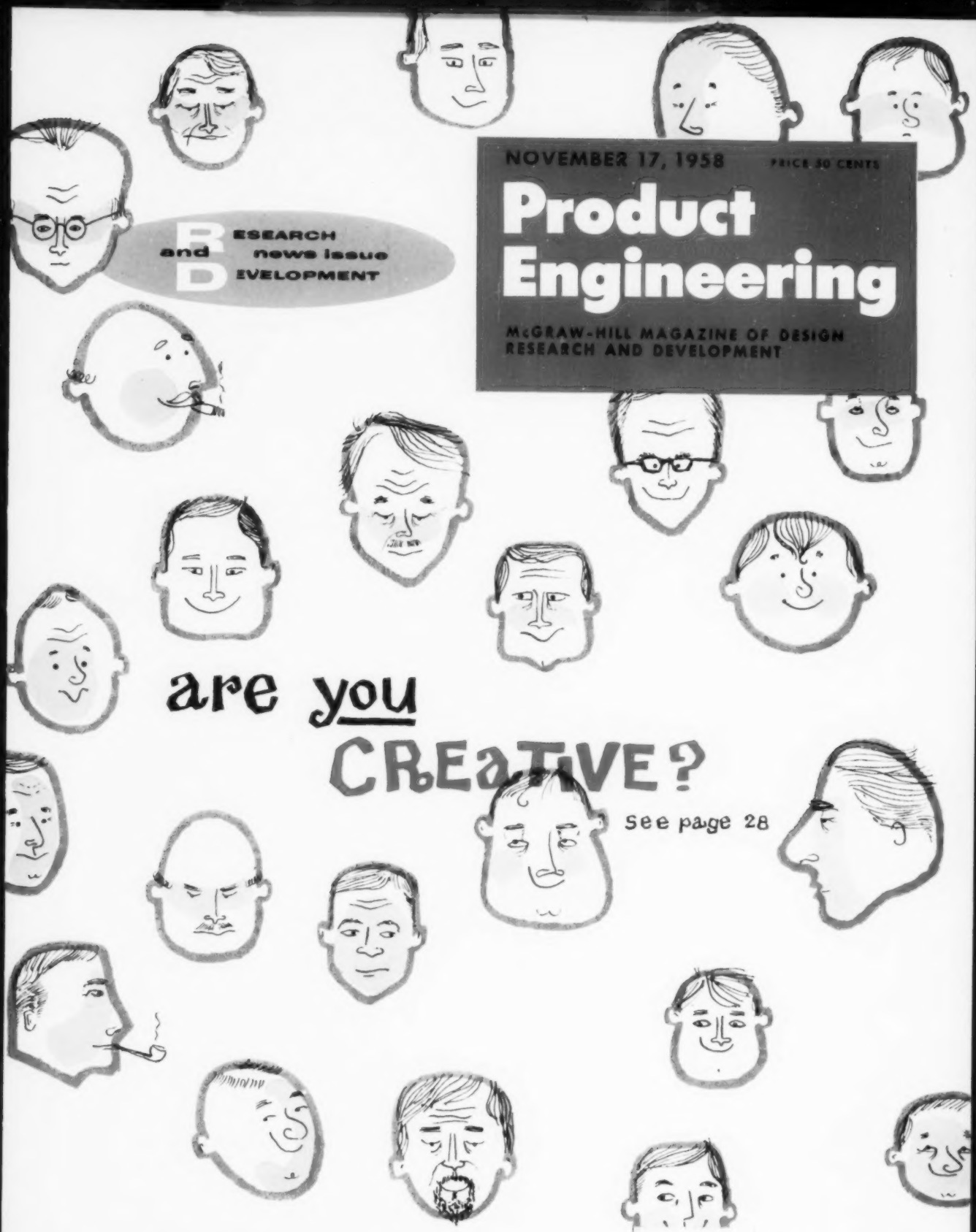

NOVEMBER 17, 1958 PRICE 50 CENTS

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN RESEARCH AND DEVELOPMENT

R&D RESEARCH and DEVELOPMENT news issue

are you CREATIVE?

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S B POWER GS D
UNIVERSITY MICROFILMS IN
313 N 1 ST
ANN ARBOR MICH A

DESIGN WITH FLAIR...

Rings up lustrous design...cash register has tough, durable Nickel plating under chromium for permanent beauty.

Bright idea for auto designers...chromium-plated hood ornament with Nickel plating underneath to keep showroom-bright...to keep base metals from corroding.

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Easy-to-clean oven interior is plated with Nickel under chrome. Nickel plating provides a smooth, bright metal foundation for an easier-to-clean, satin-smooth chrome finish. Nickel-chromium plating reflects heat, provides more even-baking.

NICKEL PLATING UNDER CHROME

INCO **Inco Nickel** *makes metals perform better longer*

the **R & D** issue

for December 1

will feature

- A gallery of photographs of the '59 car models, plus
- A critical look at American automobiles by leading figures in the design field.
- Read what the experts think about decoration, glass area, size, styling, bodies.
- • • how they would redesign for better looks, better performance.

DON'T MISS THE

DECEMBER 1

R & D issue

coming next week . . . the DESIGN issue for November 24

FEATURING

- **How many planets in an epicyclic gear?**
  A fast solution to the first part of an epicyclic-gear feasibility study.
- **How to size up electromagnetic relays**
  Selection guide to fit a relay to the specific needs of the application.
- **Packed glands for high pressure**
  Here are 11 design hints covering spacers, leak-off points and radial sealing.
- **Chart analyzes sinusoidal motion**
  Quick method finds speed, acceleration, force and other values for spring-supported masses.
- **More surface polish—less galling**
  Why cast irons are less likely to gall than the steels or brasses.
- **Porcelain enamels**
  Choose them for color, heat and stain and abrasive resistance, for texture or electrical insulation.
- **The case for swaging**
  Tips on choosing materials and specifying shapes and tolerances.

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN, RESEARCH AND DEVELOPMENT

R and D research and development news issue

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● **The creative man** (p. 28) is not always as practical as one might wish. Our latest example concerns the design of a solar-cell-powered harbor light. Researchers designed and lab-tested a light that needed no maintenance to speak of and would shine brightly from its own generated and stored power. But the commercial units wouldn't work at all. "Why not?" we asked. "Terns," said the sad-voiced salesman. "Turns? What do you mean, turns?" "No, no, terns—sea gulls. They're attracted to the silver-colored cells; they meet, have parties, romance and generally dirty things up enough so that no light gets through to be converted into electricity. As of this moment all the energy from the cells has to be used in a mechanical clapper to keep the birds off. Know anybody who wants a tried and tested harbor clapper?"

● **Arnold Toynbee** tells a story of the Brixton herring fisherman who always got a better price for his catch than his competitors because the flesh of his fish was firmer. When he retired he told the secret. He said, "When you pull in the nets with the herring you always have a handful of catfish. You throw them overboard and put the herring in the tanks. But I always put one catfish in each tank and he swims around and just raises Cain. He really keeps the herring stirred up. And that's the secret." Dr. Eric Walker, on p. 35 insists that to keep our technology firm we need our scientific catfish . . .

● **Russian inventors** have as much, if not more, trouble making a ruble out of a good idea as their American counterparts (p. 33), but it seems Russian businessmen have fewer expense-account problems than ours do. The Communist Party newspaper *Pravda* says business trips cost the Soviet government the equivalent of some $5½ million in the first five months of this year. Seldom does a Soviet bureaucrat journey to Moscow, says *Pravda*, without bringing along his secretary, an adviser and at least one assistant. Forgetting even the company comptroller for a moment, how many American wives would okay such a junket?

ABP November 17, 1958 **Product Engineering** *A McGRAW-HILL PUBLICATION* Vol. 29, No. 47 ABC

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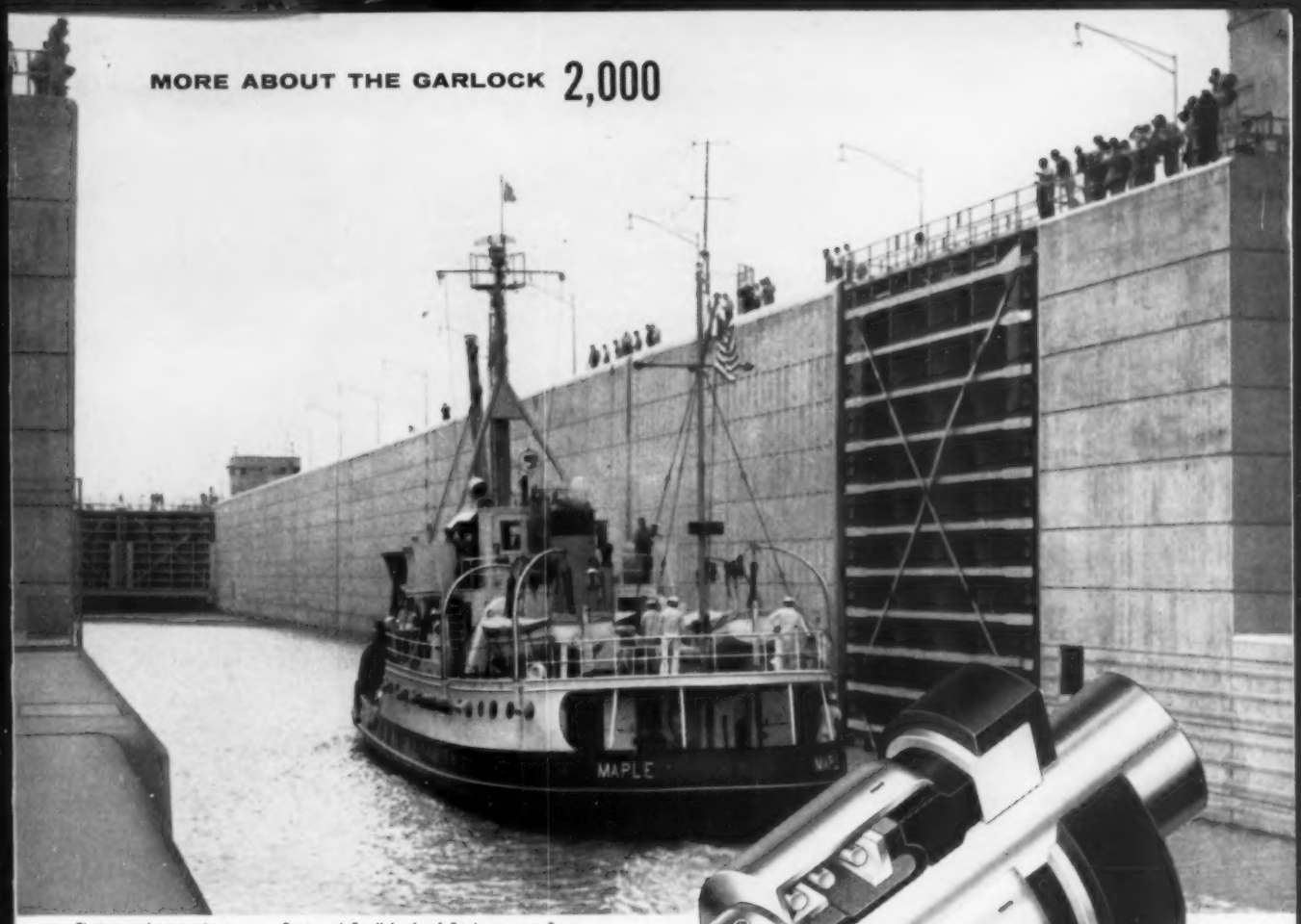
MORE ABOUT THE GARLOCK 2,000



First vessel to navigate new Bertrand Snell Lock of St. Lawrence Seaway completed on schedule with aid of Garlock Mechanical Seals.

GARLOCK SEALS help open SEAWAY on time

Builders save $100 Daily

PK MECHANIPAK —a completely self-contained seal with precision-lapped sealing faces as used on Seaway drainage pumps.

SUCCEEDING WHERE OTHERS FAILED, Garlock PK MECHANIPAK* Seals virtually eliminated seal failure on pumps used to minimize water seepage during digging of the Robinson Bay Locks. They withstood highly-abrasive clay, sand, gravel, and stone pumped out with water at a rate of 90,000 gph. Before PK MECHANIPAK Seals were applied, every four hours of pump operation meant one to two hours downtime for seal replacement. This not only consumed vital time, but forced a daily outlay of nearly $100 for new seals alone!

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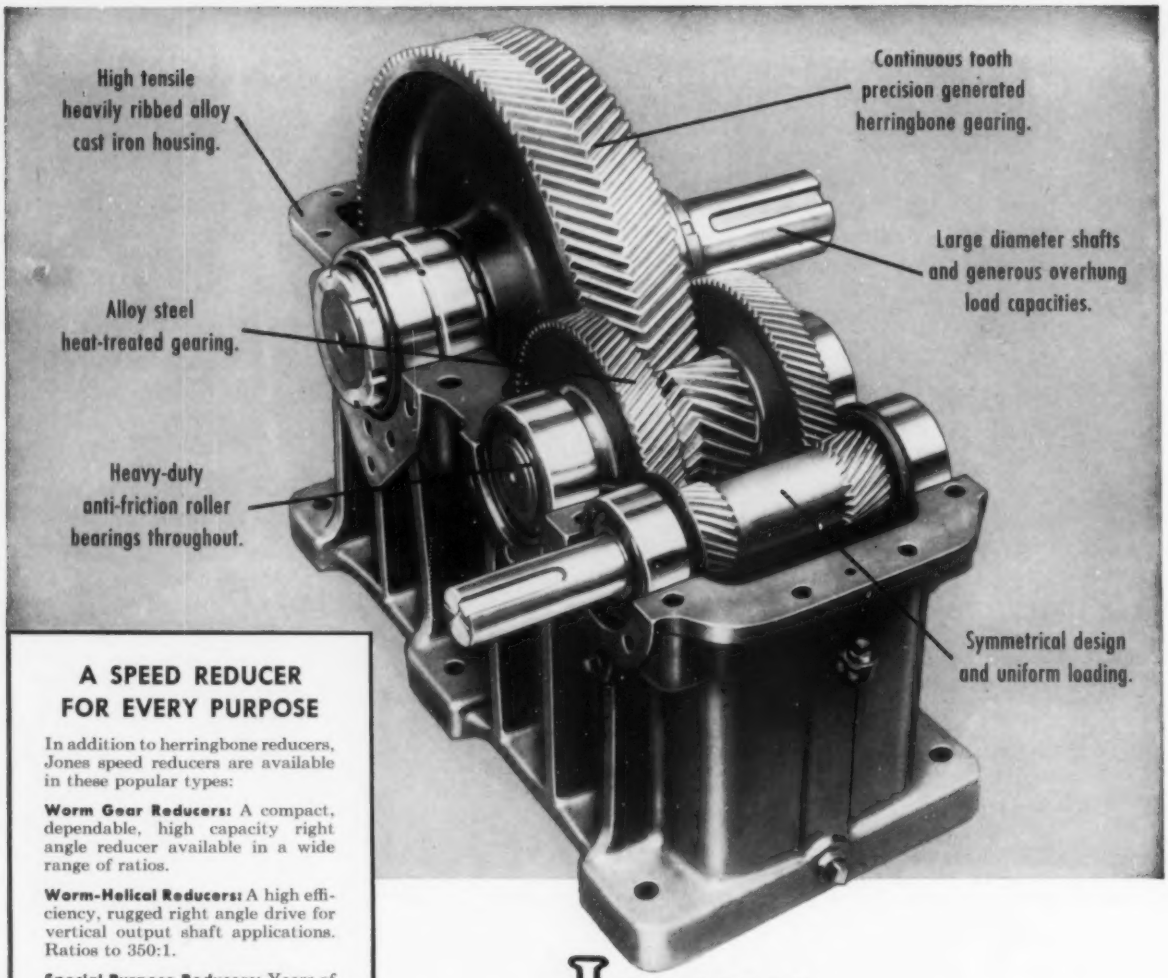
High tensile heavily ribbed alloy cast iron housing.
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Precision generated herringbone gearing of rugged heat-treated alloy steels gives these reducers the toughness to carry heavier loads, provide smoother operation, and give longer service life in the most strenuous applications. *Anti-friction bearings*, conservatively selected, provide continuous accurate gear alignment and maximum efficiency at all speeds from start to full load. *High test alloy iron housings* mean rigid protection for gears and bearings and prevent damaging deflection or distortion. *Splash lubrication system* keeps a continuous supply of oil flowing to all rotating parts, insuring trouble-free duty. Shaft extensions and joints are effectively sealed to keep oil in and dirt out.

Balanced design and top quality features such as these spell out savings through low maintenance costs, efficient operation, and exceptionally long service life. Jones Herringbone Gear Speed Reducers are available in 57 standard sizes with mechanical capacities up to 1950 H.P. and a wide variety of ratios to permit economical selection of the proper unit for each application. To find out how H-R products and services can help you, consult your classified telephone directory for the nearest H-R representative, or contact Hewitt-Robins, Stamford, Conn.

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INDUSTRIAL HOSE . . . VIBRATING CONVEYORS, SCREENS & SHAKEOUTS

DEVELOPMENTS TO WATCH...

Liquid-cooled brakes may be the only answer . . .

. . . to the long-term problem of increasing brake demands and decreasing brake space, says F. T. Cox, Jr., of Rockwell-Standard. But for the short term R-S has a less radical solution: a right-angle actuator that makes it possible to reduce brake diameter, allowing more space between rim and drum for heat dissipation, without sacrificing braking power. Indeed, says Cox, tests show an increase in brake performance, resistance to fade, and wear life.

Meanwhile, liquid-cooled brakes are under development; and considerable progress is being made. Just last month, for instance, one leading manufacturer introduced a model specifically designed for heavy-duty trucks, and others are on the way.

Silicon metal in new forms . . .

. . . that promise lower costs should result from work now in progress at W R Grace & Co's newly completed Washington Research Center.

Cutting single-crystal boules into the tiny wafers used in transistors and semiconductors often wastes metal and increases cost; but Grace researchers think they can work out production techniques that will make it possible to offer ready-to-cut (or ready-to-repurify) rod at a substantial over-all saving.

Other projects underway at the new center include studies of polyethylene and the related higher polymers, work on new types of silica for use as thickening agents in paints and plastics (including one which appears to effect a decided improvement in shelf life), and new compounds to prevent ultraviolet degradation of light-sensitive resins.

18 electroplated coatings . . .

. . . are going through their paces in a Bell Labs attempt to find new finishes for electrical contact surfaces, R. G. Baker will tell the EIA conference on Reliable Electrical Connections, to be held in Dallas next month.

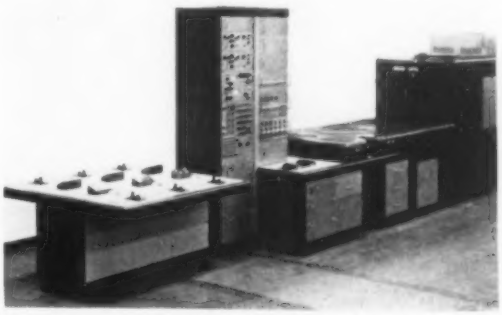
Primary emphasis right now is on corrosion and its effect on surface hardness, wear resistance, and electrical performance. Thus far, 24-carat gold coatings with a thickness of 0.0001 in. or more seem superior to any of the others. However, an electroplated lead-tin solder 0.0002 in. thick "has attractive possibilities warranting further investigation;" and copper and phosphor bronze are both doing quite well—better than nickel brass or yellow brass.

Good background information for this report, and for electrical connections in general, is contained in a publication just released by the Navy. It's not brand new (some data go back to 1954), but it does provide a good capsule review of the properties of 15 electroplated metals, it rates wear resistance, and charts give heat conductivity, melting point, resistivity, and other properties. It's PB 131496, *Guide to Electrodeposited Coatings*, 29 pp, available from OTS for 75¢.

Transistor tester . . .

. . . highlights advances in design and use of these tiny components. Completely automatic in operation, the unit pictured here, built by Stromberg-Carlson, will check transistors for saturation, leakage, and other characteristics, over a temperature range to 392 F, at rates to 430 an hour.

Though this is a prototype, S-C expects to be supplying the machine in quantity—not only for testing transistors, but also for diodes, resistors, transformers, and capacitors. Adapting the machine for other components will not be difficult, S-C says, because the unit itself is transistorized, and features plug-in modules. —ARG



Transistors test transistors in this machine, designed by Stromberg-Carlson. First model will be installed at Sperry

Tiny Tankers. Unicellular diatoms floated on prehistoric seas in infinite numbers, each encased a microscopic fat globule. Today, coalesced, they comprise the oil pools we draw upon. A wonder-of-the-world in miniature, truly a miracle of nature.

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DEVELOPMENTS TO WATCH...

Science attachés . . .

including some engineers, will be appointed soon to some nine posts around the world (*PE—Feb 10, p 29*). The new attaches are slated to go to London Paris, Bonn, Stockholm, Rome, Moscow, New Delhi, Tokyo, and one South American city—possibly Rio de Janeiro. The State Department admits that it has had trouble in lining up the caliber of scientist it wants. Plans are to appoint a science attache and a deputy, each with a different scientific background. Each would serve at least two years.

Instead of trying to collect scientific information, specifically, the attaches will try to arrange a mass exchange of data between scientific organizations in a particular country and its US counterpart.

Allowable costs for defense contracts . . .

soon will be governed by a new set of Pentagon ground rules. A revision of Section 15—contract cost principles—of the Armed Services Procurement Regulations, the new rules are due to be out by January 1.

Objective of revamping the cost rules is to clarify the fuzzy area in present procurement regulations and get a uniform policy for all three military services. Pentagon officials say the new rules will be a "liberalization of the status quo."

Industry isn't so sure about the proposed changes. Some critics claim the changes will chop away at contractor's profits. A big objection by industry centers on a provision to apply itemized cost rules to both cost-reimbursement type contracts and to fixed-price contracts.

At present, fixed-price contracts are not generally subject to a detailed allowable cost review. Industry's complaint is that after the military agree on a fixed-price contract, there is no cause to put the contractor through the wringer later on to justify the costs on which the original price was based.

Limited vs general warfare . . .

outlook by the Administration is not about to be changed. The Army, with some State Department backing, has been plugging hard to have limited warfare expenditures boosted almost twice the present size for the so-called "conventional" weapons for limited or "brushfire" fighting.

The argument is that the Lebanon and Formosa crises have highlighted our weakness to wage small wars. Recent defense budgets, Army argues, puts too much stress on preparedness for the big nuclear threat. The Administration won't budge on the matter, however. It claims the US defense forces are adequate for both types of battle.

The Army is hit hardest on the issue. It claims that the upshot of the matter is that Army will be limited to its current $1.3-billion volume of hardware procurement; will be pressurized out of the space rocket field; and will be forced to use its available dollars for improving mobility of present battlefield missiles and like equipment.

The controversial renegotiation act . . .

is once more in the spotlight. The US tax court has just finished hearing Boeing's appeal from the Renogotiation Board's ruling that the company must refund to the government $10-million gross profits earned in 1952. The case is the biggest postwar renegotiation appeal brought to court, and puts into the sharpest public focus ever the fundamental issues of the renegotiation process. The court isn't likely to rule on the appeal for another year.

Boeing's argument stressed that $5.8-million of its 1952 profits before taxes came from incentive-type production contracts, and that in effect the board penalized the company for its efficiency in cutting costs. The company argued also that it is entitled to keep the bigger 1952 defense profits than the board allowed because of the Air Force's decision to put Douglas and Lockheed into B-47 production, utilizing the jet trade secrets that were developed by Boeing.

Government lawyers played down Boeing's claim, arguing that the forced sharing of Boeing's secrets with competitors was justified since development work was done with military funds. The lawyers also said renegotiation determinations of excessive profits are made under law on all annual company receipts, that incentive-type contracts are not exempt.

World-wide ...

DEVELOPMENTS TO WATCH...

Self-welding couplings . . .

. . . have been designed in Germany. These are polyethylene plastic fittings with molded-in coils of thin electrical wire.

To join fitting to pipe or tubing, all that's necessary then is to put the parts together and connect the wire to a 12-volt storage battery or low-voltage transformer. The wire heats up, the plastic softens, and the joint is made.

In tests so far, couplings welded this way have withstood pressures as high as 60 atmospheres.

W. Tuchmantel, 22a Solingen-Wald, Schiessfach 40, Germany, makes them.

Solid fuel by a new route . . .

. . . incorporating liquid fuels in a plastic "honeycomb," is claimed by Soviet engineers. Here, the aim seems to be convenience of storage and transportation rather than actual use as a solid fuel. The honeycomb serves as a sponge which is squeezed out at point of use. Miniature presses have been designed for installation on cars, tractors and aircraft, Prof. B. I. Losev of the Soviet Academy of Sciences says, noting that use of the lightweight plastic as the "sponge" allows incorporating enough fuel in an ounce of material "to bring a quart of water to the boiling point." He also suggests that, by proper choice of the plastic, it might be possible markedly to simplify the handling of the dangerous liquid fuels used in guided missiles.

The press designed to expel the fuel from the honeycomb is already being installed on commercial as well as military vehicles, the Russians claim.

Portable office duplicator . . .

. . . weighing only 30 lb, but capable of handling standard paper sizes, has been developed by Star Carbon Mfg Co, Hertfordshire, England, British Information Services reports.

It's hand-operated, of course, but can turn out as many as 100 copies a minute. The split aluminum bearings which carry the stencil drum are hinged at one side to permit rapid changing of drums. One color can be changed for another in only half a minute, BIS reports. Conventional coated stencils are used; and there is an automatic paper feed "giving hairline registration."

Magnetic properties of cast steel . . .

. . . are adversely affected by even fractional percentages of most alloying elements, the British Steel Castings Research Assn reports. First results of a continuing study of the factors which affect the magnetic properties of cast steel indicate that copper, in percentages up to 0.35%, does no harm. But nickel, chromium, molybdenum, tin, and lead, even in quantities less than 0.1%, all seem to impair magnetic performance. BSCRA thinks gas content may also have a significant effect, and is planning further studies in this area. The Association is also planning to give special attention to the effects of small quantities of carbide-forming elements like titanium and zirconium.

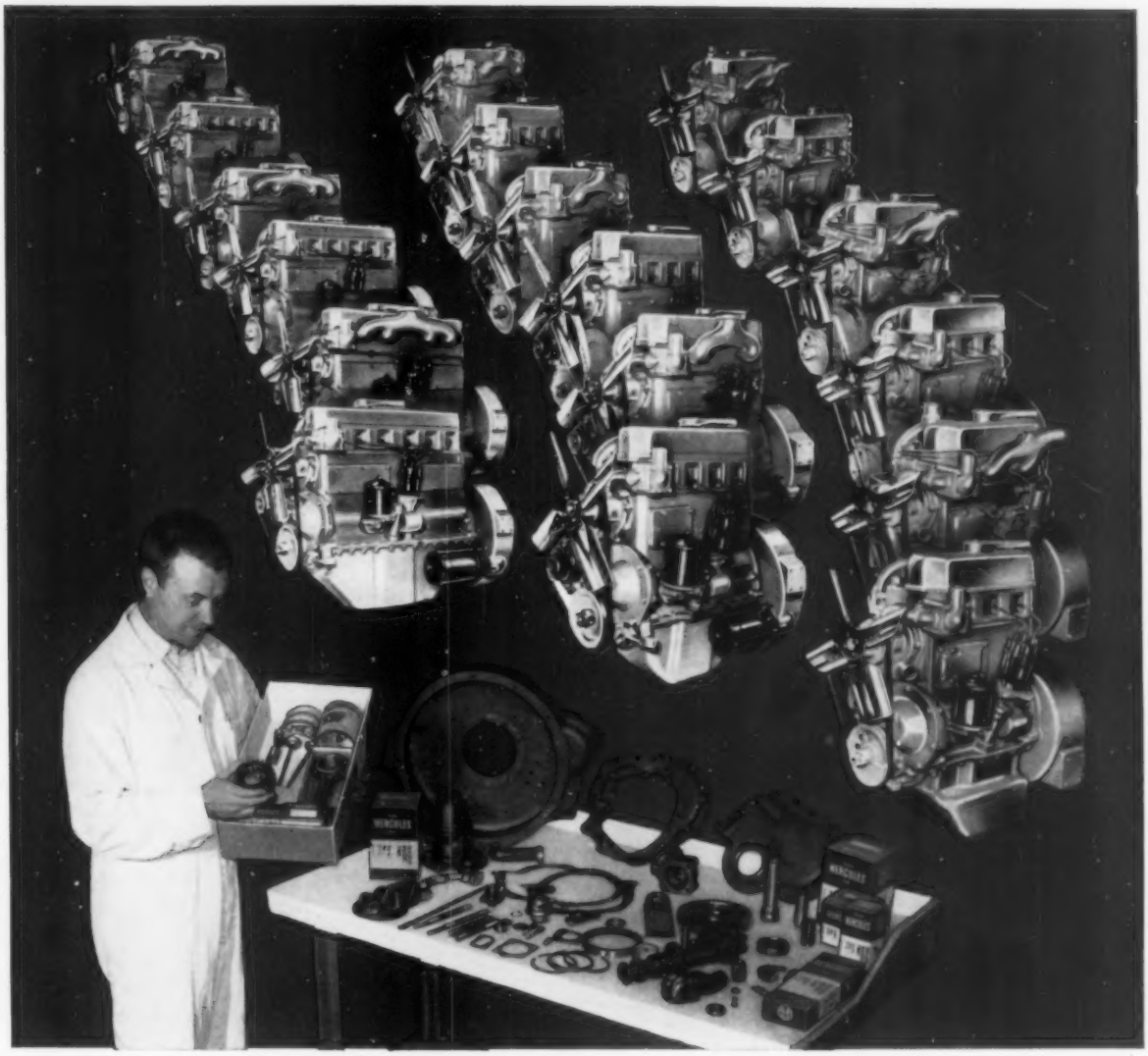
New process for separating isotopes . . .

. . . developed at the University of Marburg in Germany may have application in other devices that require handling and separation of gases (masers and atomic "clocks," for example, *PE—Jan 13, p 10*).

Instead of depending on diffusion of atoms through porous membranes, or on electromagnetic techniques, this one propels gases through specially designed nozzles at supersonic speeds.

With the proper nozzle configuration, separation efficiency is said to be quite high, and separation costs surprisingly low.

Also under test, in Holland as well as Germany, are huge ultracentrifuges that can spin materials with a force of 100,000 g or more. While not yet economically competitive with techniques now in use, this type of unit looks extremely promising.



One set of spare parts serves all these 18 HERCULES engines

Here's parts interchangeability to warm a maintenance man's heart! Hercules designed the new DD diesel and GO gasoline engines with the user in mind: succeeded in achieving a unique degree of interchangeability that reduces spare parts requirements for Hercules-powered equipment to a minimum.

Actually, the illustration above doesn't tell the whole story. To do that, we'd have to show 6 power units as well as all 18 models of 3, 4, and 6-cylinder engines available in the DD and GO series—a total of 24 power plants using many of the same wearing parts!

This maintenance economy is another reason you should specify dependable Hercules gasoline, diesel, or LP-gas engines for the equipment you build. For the full story on these engines, write Hercules Motors Corp., Canton 2, Ohio—or call your Hercules distributor: there's one in the Hercules worldwide network near you.

HERCULES

HERCULES MOTORS CORPORATION
Canton, Ohio

What's happening in SCIENCE

New pumps for purity

Pumps for capturing atoms instead of moving them are the hottest item in low-temperature studies. They're important, too, in research on devices that require ultrahigh vacuums for dependable operation – microwave tubes and thermonuclear machines for instance.

These are "ion pumps," designed to produce vacuums of 10^{-8} mm Hg and below.

Best known is the Herb Evapor-ion pump, which takes advantage of the "getter" or capture ability of titanium to trap wayward atoms and produce vacuums down at least to 10^{-9} mm Hg.

A spool of titanium wire is positioned in a metal casing, equipped with a heating post and an accelerator grid. When tip of the wire touches the heating post, titanium is vaporized and heads for the walls of the case, where it traps gas atoms.

That's all there is to it. But actual design and construction have presented plenty of problems, and commercial units have become available only recently. Furthermore, no one claims to have yet reached the peak of construction or efficiency. New designs and new types of "getters" are being investigated all over the world.

Earlier this year, for instance, Varian Associates unveiled its VacIon high-vacuum pump–a cold-cathode unit in which titanium or some other reactive metal serves as the cathode, and gas atoms are trapped at the anode by sputtered metal. A surrounding magnet aids in ionization.

Japanese researchers have developed a barium-ion pump that also represents a new and promising approach to production of high vacuums. This one is more conventional in basic design, in that it resembles a vacuum tube and uses a hot-cathode discharge in a magnetic field. Researchers in Germany, France, and Russia are also developing new designs.

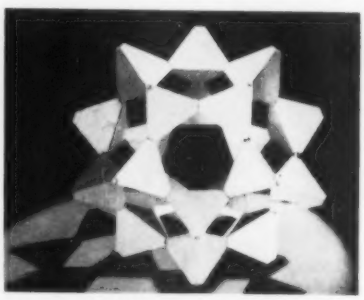
Many "getter" materials are being tested–both common and rare metals. One of the most promising, for instance, is the rare earth, gadolinium (see p. 12). According to Lewis Hall of Varian, this may permit even greater pumping speeds than barium or titanium. But its current high cost puts a damper on any plans for immediate commercial use.

What makes it glass?

For an old material, glass still poses a surprising number of technical question marks, notably in regard to its structure.

Latest suggestion is from L. W. Tilton of the National Bureau of Standards. To explain the differences between glassy and crystalline states he postulates a structural unit–the 'vitron." He describes it as "a submicroscopic cluster of pentagonal dodecahedra" (see photo) which fit together only when slightly distorted, and are loosely joined together by "connective tissues" that have weaker bonds but greater densities than the vitron.

The built-in distortion and the nature of the bonds can explain, he thinks, the anomalous thermal and pressure effects observed in glass and its semicrystalline behavior in many circumstances.



New theory of glass structure postulates pentagonal structure like this, with subunits of silicon-oxygen tetrahedra.

New Words

IV: The mighty mites of electronics

A host of tiny devices are now ready to serve as modulators, switches and amplifiers in electrical and electronic equipment. Some operate at room temperature; others in a bath of liquid helium; some are sensitive to electrical currents and magnetic fields; others to heat and light. Here, as installment IV of our continuing series of definitions (see *PE*—Nov 3, p 10, for a list of earlier installments) are four transistor-type devices. Others will be covered later.

Transistor: Best known of the solid-state, semiconductor devices that "put to work our ability to control the flow of electrons in solids and take the place of vacuum tubes," the transistor is defined as "an electronic device for amplification and control which consists of a semiconducting material to which contact is made by three or more electrodes." That's all there is to it; but, as everyone now knows, the transistor is now indeed "taking the place of vacuum tubes"–in everything from hearing aids to computers.

Developed by Bell Telephone Labs, the transistor is produced commercially by more than a dozen companies, in standard types and such variations as these noted below. *Trisistor* and *Thyristor* are trade names.

Trisistor: modified alloyed junction transistor, said to have thyratron-like characteristics, designed for use as a trigger in switching circuits.

Thyristor: modified germanium transistor, said to be fast-acting and to have a low power requirement.

Spacistor: semiconductor amplifier for high-frequency operation, it is basically similar to transistor but with a different arrangement of injector, collector and modulator connections.

brief . . .

Isotopes go "commercial" with the formal opening of the AEC's long-promised Fission Products Plant (*PE*—Sep 16 '57, p 9) and the announcement that standard samples of more than a dozen radioactive materials, previously available only from NBS, can now be obtained from commercial sources. Furthermore, the commercial price of the standard samples ($25 in most cases) is below the NBS price; and isotopes from the AEC plant will cost about a tenth of what they cost before.–ARG

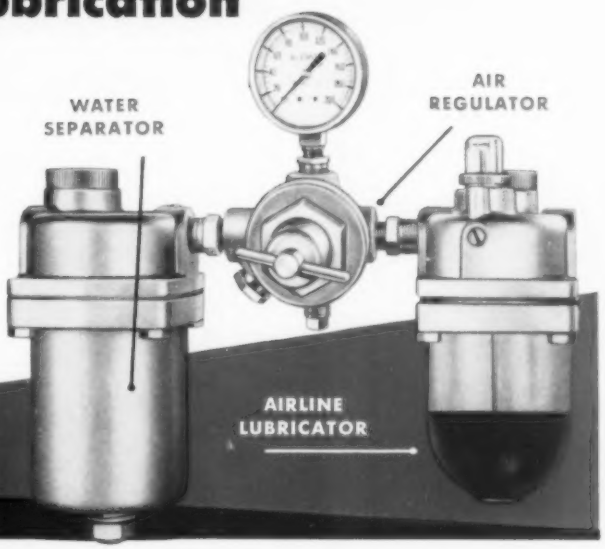
Alemite "Tri-Duty" air line controls!

All-New...for the cleanest, driest, best-regulated air line lubrication

Automatic Water Separator! Removes all of condensate, all the time. Traps dirt particles to prevent damage to sensitive air line devices. Handles all air line pressure up to 200 PSI and flow volume from 5 to 50 CFM.

Air Regulator with Gauge! Assures accurately controlled air – prevents erratic operation and damage to equipment. Adjusts to any pressure up to 200 PSI.

Automatic Air Line Lubricator! Provides automatic lubrication to air-operated mechanisms. Air stream controlled by compensating Venturi valve. Nine-ounce capacity.



All-New features offer outstanding advantages:

1. Single Unit Control Lubricator. Regulates the exact oil output required.

2. Visual Oil Counter. Oil sight dome in lubricator permits visual observation and count "per-drop" of lubrication.

3. Uniform Oil Mixture. Regardless of air pressure and volume!

4. Consistent Output. Oil and air mixture proportionately constant.

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9. Filter Oil Tube. Removes all contamination from oil passing into air line.

10. Concentric Venturi Design. Assures constant, uniform mixture of air and oil.

11. Contamination-Free Air. Removable strainer in Air Regulator traps minute dirt particles.

12. Effective Control of Air Flow. Air Regulator eliminates excessive pressures and sudden surges.

13. 100% Condensate Removal. Water Separator removes and automatically dumps 100% of the condensate present in air lines.

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What's happening in MATERIALS

More plastics for the hot spots

The plastic that can't boast of resisting heat at least up to 450 F is out of date these days. With resins being developed for continuous service in the 800-F to 900-F range by laboratories across the country (*PE—May 26, p 19*) and the discovery that plastics may do better than metals for short-term service at ultrahigh temperatures (*PE—June 16, p 5*) the old rules of "plastics for low temperature only" are going out the window.

At a recent SPI meeting, for instance, J. H. DuBois, surveying recent plastics developments, described Teflon-bonded ceramic-fiber laminates that hold their shape and much of their strength even after the Teflon itself has burned away; new semi-organic boron and phosphorus compounds that seem serviceable to 900 F, and a host of phenolics offering improved heat and flame resistance.

Most suppliers of laminating resins, and a good many users, are experimenting with reinforcements and molding processes as well as with the resins themselves in an effort to produce new laminates for the ultra-high temperature field. Narmco Resins & Coatings, for instance, says some of its more recent samples, exposed to arc jets at temperatures of 10,000 F and speeds approaching 1200 fps, "show erosion of less than $\frac{1}{8}$ in. after 70 sec."

How metals behave when the heat's on

Much useful data on high-temperature performance of metals is coming from Air Force-sponsored research programs aimed at developing better materials for the 1000 to 5000-F range.

Southern Research Institute, for example, has been studying the performance of oxygen-free copper, A-nickel, ingot iron, tantalum, 316 stainless, and graphite, and has turned up a number of interesting results:

- While strength of the metals decreased progressively under very rapid heating, that of graphite increased, so that, above 4000 F, it was stronger than any of the metals. At temperatures to 3000 F, though molybdenum was strongest; and tantalum held the honors in the 3000 to 4000-F range.
- Despite loss of strength, the load-carrying capacity of the metals tended to increase with increasing strain rates; while that of graphite seemed unaffected.
- Electrolytic tough-pitch (ETP) copper showed a constant relationship between ultimate shear strength and ultimate tensile strength at all temperatures to 1800 F under equal load, the former being 60% of the latter.

A report on SRI's first two research projects, notable for the number of charts it contains, is now obtainable from OTS. It's PB 131664, priced at $3, and, of its 206 pages, more than two-thirds are charts and tables.

Rare earths: more and purer

The boom in rare earth metals, sparked by the atomic energy program, but by no means confined to it, continues to bring new suppliers and improved materials.

Michigan Chemical Corp, for instance, which began by offering four of these metals (gadolinium, dysprosium, erbium, and yttrium) in "commercial quantities," now adds seven more to its standard stock list: praesodymium, neodymium, terbium, holmium, thulium, ytterbium, and lutetium. All are supplied in better than 99% purity, in ingots 1 to $3\frac{1}{2}$ in. dia, and special shapes to order.

At the same time, St. Eloi Corp, already supplying a full set of rare earths, is now working on a new repurification process which, it is hoped, will not only make purer metal available; but also help to decrease its cost. Look for more news of this development in the next few months; and, for information on how to use these unusual metals, see *PE—Jan 27, pp 7 and 8; Mar 24, p 7; and June 30, p 11.*

briefs . . .

Oil-impregnated sintered nylon can reduce instrument errors, says Barden Corp, Danbury, Conn, citing the example pictured here. It's a gyro rotor bearing designed for an inertial guidance system:

By changing the bearing design to substitute an impregnated nylon retainer for the standard phenolic plastic, Barden says it has been able to "reduce drastically" the oil mass shifts that induce navigational errors. Barden claims the sintered nylon will retain 20 to 25% of its own weight of oil even under an acceleration of more than 800 g; and says retainers have passed severe long-term performance tests.

New magnesium alloy HM21XA-T8, is superior to standard HK31A in several respects, says C. P. King of Marquardt Aircraft: It does not require heat treatment by the user, offers a high strength-weight ratio in the 700 to 900-F range, and has good weldability and good formability. However, to take full advantage of its elevated-temperature properties, a coating for continuous service above 700 F is still needed. There is a new thermosetting resin that will protect magnesium against corrosion at temperatures to 700 F, on a continuous basis, but it offers only short-term protection above that point. Metal coatings, notably electroless nickel plating (see also p 5), are now being investigated. —ARG

*Another fine product gains NEW S.A.**
By Switching to the Saginaw Screw

FRANK S. BUCKINGHAM
Chief Engineer, Static Testing Machines, Baldwin-Lima-Hamilton Corp., reports:
"Using a Saginaw Screw on this tester reduced required horsepower from 15 to 5."

WORLD'S MOST EFFICIENT ACTUATOR OPERATES 75-TON BALDWIN TESTER WITH 5 H.P. INSTEAD OF 15

When you can cut power requirements 66% you give your product a lot more ***S**ales **A**ppeal—and that's just what Baldwin-Lima-Hamilton has done by switching from an acme thread to a preloaded Saginaw b/b Screw. What's more, it speeds up cycling and ends fretting corrosion, too.

The truly amazing ability of the Saginaw Screw to convert rotary motion to linear motion with over 90% efficiency is saving power, space, weight and assuring smoother, more dependable performance in countless products from miniature electronic controls to giant production equipment.

Perhaps the Saginaw Screw can give *your* products that vital new **S**ales **A**ppeal you're looking for right now. To find out, write or telephone Saginaw Steering Gear Division, General Motors Corporation, Saginaw, Michigan—*world's largest producers of b/b screws and splines.*

**Give your products NEW SALES APPEAL... switch to the*

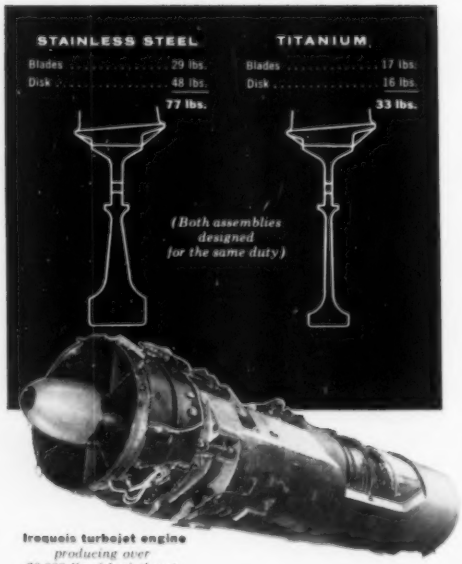
Saginaw ball bearing Screw

Avro CF-105 Arrow
Canada's newest supersonic interceptor

In the Arrow's twin IROQUOIS turbojets...

TITANIUM CUTS WEIGHT 57%

in compressor blade assemblies



Iroquois turbojet engine
producing over 20,000 lbs. (dry) thrust.

Twin Orenda-built Iroquois jet engines will speed the Avro Arrow through space at 20 miles per minute. In these advanced design turbojets, as in the aircraft structure itself, every pound of weight-saving becomes a vital consideration.

To Orenda designers, titanium's high strength-to-weight ratio proved a double bonanza. By using titanium in place of stainless steel for compressor blading, much lighter titanium disks could also be used. *Result: A total weight saving in the assembly of 57%* (see diagram). In addition, lighter structural members could be used, contributing further weight savings and improving performance.

Mallory-Sharon, in cooperation with Atlas Titanium, Ltd., produced many of the titanium alloys which help make possible the Iroquois' superior performance. These same technical and production facilities are available to you *now* . . . to assist you in using titanium's outstanding physical and mechanical properties to maximum advantage. Write us for information or technical assistance.

MALLORY SHARON

MALLORY-SHARON METALS CORPORATION • NILES, OHIO

Integrated producer of Titanium • Zirconium • Special Metals

Product Engineering HORIZONS

November 17, 1958

SAFETY DOESN'T SELL

New York adopts an anti-jaywalking ordinance that proves unenforceable. Ford attempts to promote seat belts, special door latches, other devices–and is forced to a mid-season about-face in sales effort. Sports veer from the safe and sane to the thrilling and risky–and sports equipment with it.

There's a simple reason: Safety doesn't sell. As a matter of cold fact, who is really interested in safety? Outside of the safety director and the insurance man, who really cares?

The willingness to risk life and limb, the lack of concern about the safety of others, the pleasure in sports events based on mayhem–these are all hangovers from savagery, the law of the tooth and claw. And we love 'em–the man who doesn't is considered a bit queer. Muscles and daring are the measures of a man–not mentality and caution.

About the only thing that seems to dent this armor are the gruesome pictures of smashups. We even attempt to kid about those, to prove we're not "chicken."

Even the engineer apologizes for any safety consciousness he may show. He obviously doesn't want to talk about it, that's certain–the hundreds of papers in this year's National Safety Congress include only two concerned with safe design. Yet the design room is where safety should start.

With no intent to make the industry a whipping boy, let's consider our greatest killer–automobiles. Last year they killed 40,000, injured a million. Yet the $5-million Detroit annually pours into safety research must be on brakes, frames, lights–where it doesn't show. Such obvious troublemakers as projections within and without the car, seats that don't hold the human projectile, powerful engines that make the car into a missile; these go unchallenged.

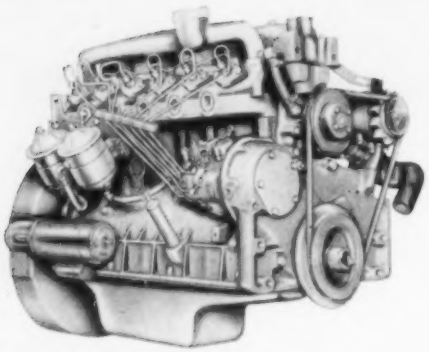
Cornell and UCLA and other labs have shown the designed-in hazards of automobiles. Cornell even built a prototype car with 60 designed-in safety features. The instruments can be read at a glance; there are warning lights for dangerous conditions. The doors are easy to get in and out of. Projections are removed. The car is protected on all sides. The steering post is replaced by a padded box with levers. Light underneath at night outlines the car even from the side. The driver sits in the middle, where he belongs, held in by arms.

There's no chance whatever that these tested safety ideas will be used. They're not stylish nor fashionable. They take too much risk from the plaything that we've made a necessity. We want an element of chance in our driving, a gamble that we may lose.

So it is with other products for home, office and shop. We object, subconsciously, to safety designed in. "We the people" are still the fatalists, the chance-takers.

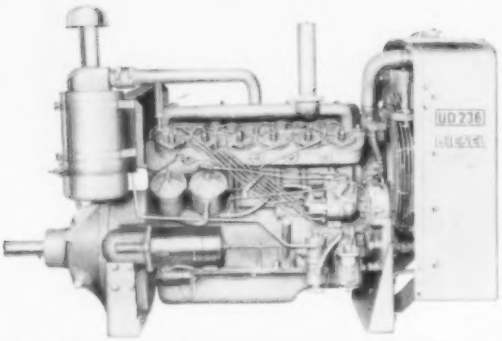
Can the saner side of the designer do anything about it? Yes, by being conscious of safety all along the line, by making his gamble that of designing the product safe against even the foolhardy human who will use it, and by doing it so well that it doesn't show.

It's a blood-curdling statement to remember, not as an excuse but as a challenge–safety doesn't sell.



UD-282 6-CYLINDER ENGINE

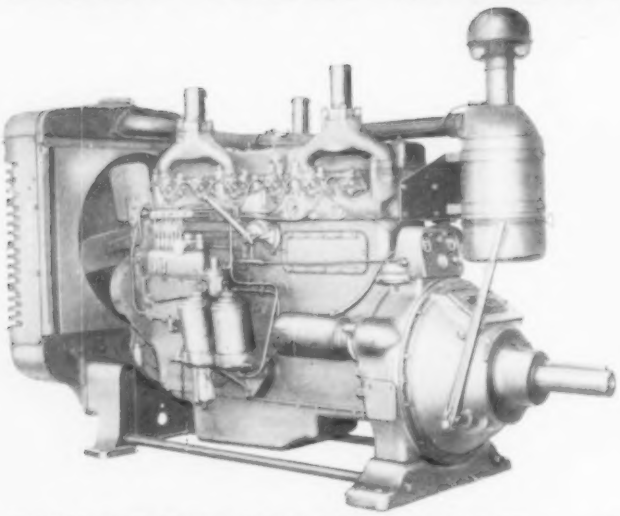
Max. engine hp—95 @ 2400 rpm. Direct electric starting. 3-11/16 x 4.39. 282 cu in displ. 18:1 compression ratio. Matched power unit components available.



UD-236 6-CYLINDER OPEN TYPE POWER UNIT

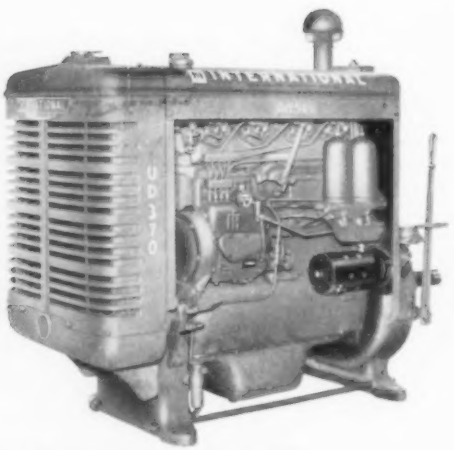
Max. eng. hp—75 @ 2400 rpm. Direct electric starting. 3-11/16 x 3-11/16. 236 cu in displ. 17.5:1 compression ratio.

Four new diesel engines that



UD-554 6-CYLINDER OPEN TYPE POWER UNIT

Max. eng. hp—150 @ 2300 rpm. All weather electric starting. Bore and stroke: 4⅝ x 5½. 554 cu in displ.



UD-370 4-CYLINDER POWER UNIT

Max. eng. hp—95 @ 2200 rpm. Gasoline conversion starting. Bore and stroke: 4⅝ x 5½. 370 cu in displ.

pass all product power tests

Spend five minutes comparing these four new International diesel engines against any checklist you or your customers might use and you'll discover they pass all product power tests!

Well-known manufacturer? The No. 1 builder of 6-cylinder engines built exclusively for heavy duty. Dependable and economical? The very two features that win international acceptance for these engines. Components? All matched power unit components needed to speed installation including air cleaner, base, radiator, and enclosure. Field service? No engine manufacturer supplies finer on-the-job parts and service support in the domestic or foreign markets. Price? Compare and you'll find the price tags on these Internationals as pleasing as their performance.

Follow-through? Just write International Harvester Co., Construction Equipment Division, Melrose Park, Illinois. You'll get complete information on these new engines or any of 22 International 4, 6, and V-8 engines.

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A COMPLETE POWER PACKAGE: Crawler and Wheel Tractors . . . Self-Propelled Scrapers . . . Crawler and Rubber-Tired Loaders . . . Off-Highway Haulers . . . Diesel and Carbureted Engines . . . Motor Trucks . . . Farm Tractors and Equipment.

Capital Spending Levels Out; No Boom In Sight

NEW YORK—Manufacturing firms are planning to pare capital budgets slightly next year, a survey by the McGraw-Hill Dept of Economics reports. Investment in new plant and equipment now looks as though it will run about $9.7 billion in both 1959 and 1960, compared with $10.0 billion this year and $13.6 billion in peak year 1957. Plans for 1959, the survey notes, are preliminary, pending year-end budget reviews.

For industry as a whole, including commercial firms and utilities as well as manufacturing industries, capital investment will edge ahead of this year. Figures—again preliminary—indicate $33.0 billion for 1959 and $32.7 billion for 1960, against $32.9 billion this year and $38.4 billion in 1957.

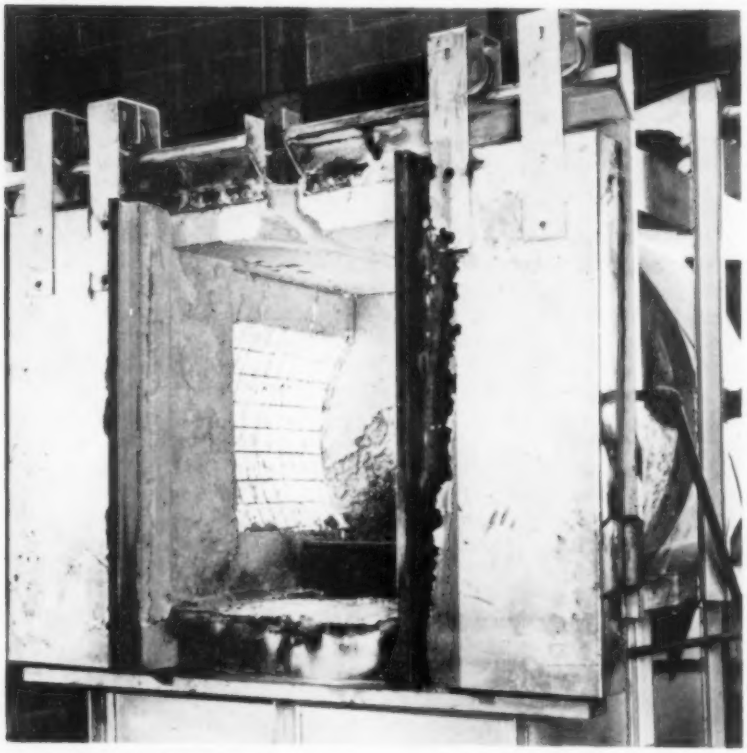
Capital budget cuts next year will be especially sharp in iron and steel industries (13%), nonferrous metals (22%) and transportation equipment (13%). These come on top of cuts ranging as high as 48% between 1957-58. The auto industry, in contrast, will increase capital spending about 4% next year following a 39% slash this year.

Machinery, electrical machinery and other metalworking industries will hold spending about the same after cuts this year ranging from14-23%.

CAPITAL BUDGET DIP

Capital budgets will run slightly lower next year, the report says, even though manufacturing industries anticipate improved sales and much of their industrial equipment needs modernizing. As a whole, manufacturers expect sales to rise about 9% in physical volume next year. Some of the largest increases are anticipated by iron and steel firms (26%) and autos (20%). The transportation equipment industry foresees sales improvements of 2% and machinery 8%. In a recent month industry was operating at about 80% of capacity, but prefers to run at about 90%, the report indicates.

In spite of a 50% increase in industrial capacity since 1950, about half of today's production equipment was installed before Dec 1950 and less than ¼ after 1950. Modernizing such outdated equipment, the survey adds, would cost industry $35 billion, including $854 million for producers of transportation equipment, $3.2 billion for producers of machinery, $2.2 billion for autos and trucks, and $2.4 billion for other metalworking firms.



Luminous-wall heat-treating . . .
furnace, developed by A F Holden Co, Detroit, is lined with special porous brick that permits mixture of gas and air to pass through uniformly. Brick chamber is encompassed by steel shell. A proportioned mixture of gas and air is forced into open space between brick and steel shell. Pilot light inside the brick chamber fires the mixture as it leaves the brick. New technique gives uniform and almost immediately available heat throughout the furnace chamber. Mixture acts as coolant for brick which serves as heat exchanger. By pumping air alone furnace is rapidly cooled.

CAPITAL SPENDING PLANS OF MFG COMPANIES

(Millions of Dollars)

INDUSTRY	1958 Est*	1959 Planned	1960 Planned
Iron & Steel	$1,199	$1,043	$1,043
Nonferrous Metals	510	398	295
Machinery	1,025	1,031	1,099
Elec Mach	517	507	583
Autos, Trucks	646	672	645
Transp Eqpmt	408	355	359
Other Metal-working	727	737	722
Chemicals	1,400	1,288	1,211
Paper & Pulp	602	566	634
Rubber	136	163	187
Stone, Clay & Glass	404	477	461
Petrol Rfg	606	588	623
Food & Drink	737	813	800
Textiles	264	229	273
Misc Mfg	828	841	720
All Mfg	10,009	9,678	9,655

* US Dept of Commerce, Securities & Exchange Commission, McGraw-Hill Dept of Economics

The Woman Engineer: A Rarity in Other Countries

• As in the US *(PE—Sep 1, p 34, and Sep 8, p 19)*, the female of the species is rarely found in the engineering profession overseas—although companies there will hire her to alleviate the engineer shortage.

• German firms have a 3-year program that enables talented girl high-school graduates to gain an "engineer" title in 5 years.

LONDON—Women engineers are still rarities in Britain, and regarded with awe and even suspicion by their male colleagues. But they are in demand. The main industries to which they are drawn are electrical engineering and aviation. A few become designers, mainly in electrical engineering.

Despite a shortage of qualified engineers in Britain, only 500 of the country's 80,000 engineers are women, although many have entered industry as laboratory assistants, statisticians and technical librarians.

Two main reasons account for the lack of women engineers: Women are not attracted to engineering because of its association with "dirt and grease"; employers are cautious about training girls for engineering degrees because they leave industry to get married.

"But," says Madeleine Nobbs, president of the Women's Engineering Society, "as engineering becomes more specialized every year, more girls will enter the field." On the question of marriage, the Society says the type of girl who becomes an engineer is unlikely to throw up years of very hard work and expensive training for wedlock. "If a girl does get married, she invariably stays in engineering—it's her vocation."

Most of Britain's major aviation, electronics, electrical and automobile companies say they are willing to hire and even train women but cannot find suitable candidates. The Department of Scientific & Industrial Research, a government-sponsored body, says it employs nearly 4000 engineers, but only one is a woman. And in five years of advertising for more engineers, it has not received one application from a qualified woman.

The Society blames the schools for the shortage of women engineers. "If a girl does think of engineering," Miss Nobbs says, "she is discouraged by her parents and teachers because they do not think it a 'lady-like profession'."

BONN—There are few women engineers in West Germany. The Association of German Engineers estimates less than 1% of 200,000 German engineers are women. However, this is only a rough guess; nobody has ever become sufficiently interested to even count the number of women engineers in Germany, much less to promote their interests.

This picture is not likely to change quickly; there are practically no girl students at the engineering schools. Of the 30,600 students attending German technical universities, approximately 1200 are girls. Emphasis here is on basic research and theory for a degree comparable with the master's.

Even those who graduate will not necessarily become engineers. Of the 146 female students(compared to 7323 males) now attending Aachen Technical University—one of Germany's largest—only 3 are in electrical engineering, 2 in mechanical engineering, and 12 in mining engineering. Of the 3 female electrical engineering students, all are foreigners.

When graduated, women engineers usually find jobs in industrial research departments, sales organizations or as assistants at technical universities. Perhaps a dozen of them have reached leading positions, including appointments as university professors.

Neither the government nor industrial associations are seriously considering promoting female interest in engineering. But a few companies are recruiting female talent and report good results.

Siemens maintains a school where girls who graduate from high school with exceptionally good grades in mathematics and physics are trained for two years—½ year practical, 1½ year theoretical studies. They pay no tuition and even collect a monthly $25 allowance. After graduation they become "electrical engineering assistants" and are employed by the company. If the girls show good results they earn the title "engineer" in five years. And as full-fledged engineers they get jobs in research, sales or other spots, excepting production positions where they would have to supervise male workers. Although there is no long-term employment contract attached to this education, Siemens says that few girls switch to another company.

Each year, 90 "electrical engineering assistants" are graduated from the Siemens school. A similar school is maintained by AEG, and non-company schools for female technical assistants are available in Luebeck and Berlin. In these German programs, about 200 such engineering or technical assistants graduate each year.

STOCKHOLM—Only about 2% of the engineering students in Swedish colleges and universities are women. In industry women are even less evident. Swedish firms now employ about 30,000 engineers, but only about 200 are women for full-time work and about the same number for part-time jobs.

Very few women are found in design engineering. Most with technical backgrounds become architects or chemists, with a smattering venturing into electrical engineering and telecommunications. The Royal Institute of Technology reports that it has graduated 98 female engineers since 1915 and 90 of these are still working.

For the qualified woman, job opportunities are ample. But the problem for both men and women in Sweden is getting an education with today's scarcity of teachers and equipment. Technical colleges now enroll 4800 students of whom 110 are women. The two higher academic institutions—The Royal Institute of Technology in Stockholm and the Chalmers Technical University in Gothenburg—have enrolled 4600 of whom 90 are women.

PARIS—Today there are about 120,000 engineers in France and just under 2% are women. Half of the women engineers in France work in the chemical industries. The rest are scattered widely over the industrial spectrum. Very few are design engineers. In

fields where women engineers are accepted, some have reached the chief-engineer status.

Main difficulty for a woman who wants to enter engineering is getting the necessary training. Most engineering schools belong to the government's higher-education system and, although not restricted to men, these schools have stiff competitive examinations to determine who gets in. Students preparing for the examination follow a special program—heavy in mathematics and sciences. But not many of the junior colleges for girls offer this special program. Ecole Centrale, the top engineering school that admits women, graduated 211 men and one woman last year.

Nevertheless, about 200 women a year do get engineering degrees. About half of them are graduates of Ecole Polytechnique Feminine, a private school. The other half come from coed schools and, especially from chemical engineering schools, which account for 60 or 70 of the yearly total.

With a diploma, a woman can easily find a job because of the engineer shortage in France. All of the 1958 class at Ecole Polytechnique Feminine, for example, had accepted job offers before they graduated. Starting pay for women is substantially the same as that for men.

Because they can find jobs and carve out satisfying careers, women engineers have not needed to band together to promote their professional interests. Therefore there are no exclusively female engineering societies, except perhaps the Alumnae Association of the Ecole Polytechnique Feminine.

ROME—The few women who do undertake an engineering career here—about 1% of all engineering graduates—usually end up in laboratories or patent offices. A woman in design engineering is unheard of. Most do not want such jobs and industry does not want them. Many enter other scientific fields, such as physics, chemistry and mathematics to teach or work in laboratories.

Italian industry and engineering associations believe that women engineers will always be an exception and cannot, therefore, be counted on to alleviate engineering shortages.

AMSTERDAM—Women ingenieurs in Holland have the same job opportunities as men because of the persisting shortage of professional people. But few women graduate from Delft or Eindhoven—the two technical universities that prepare young people for professional careers.

In 1957–58, the student body of Delft—the larger of the two—was made up of 5809 students. Only 104 were girls. Building and construction attracted the largest number of women scholars last year (38) and chemistry the next largest (29).

Holland is suffering also from a shortage of college-graduated technicians and academy-graduated people who do much of the nation's design.

Rollaway front end . . .
of this Atlas ½ ton delivery truck is shown in front of the complete truck displayed at the International Commercial Vehicle Exhibition in London. The front end shown here includes a 35 hp engine, gearbox and suspension. Made by the Standard Motor Co., the 180 cu ft van has a turning radius of 14½ ft.

Jet Passes Vertical Flight Test

LONDON—The first free take-off and landing of Short Bros and Harland Ltd's pure jet research aircraft, the SC1, took place recently at Sydenham Airport, Belfast, Northern Ireland, where it has been tethered to a gantry for hovering tests.

After rising slowly into the air from a metal platform, the plane hovered motionless for a few moments, moved foreward for some distance and then made a perfect vertical landing on the runway, according to the company. The SC1 uses four downward pointing Rolls Royce engines to rise vertically and a separate rear-exhaust engine to fly forward.

Coming Events to 1964

NEW YORK—A publication listing engineering and technical conventions for the next five years is available from Industrial Relations News, 230 West 41st St., N. Y. 36, N. Y. for $4.00 per year. National, regional and state meetings will be listed chronologically and according to subject matter.

Army's new Doak 16 VTOL aircraft . . .
is shown hovering over Torrance Municipal Airport, Torrance, Calif., in first photos released of the craft designed and manufactured by Doak Aircraft Co. Ducted propellers on wing-tips are here aimed straight up for vertical flight. When the ducts are slowly rotated forward, the craft will shift to horizontal flight; and when rotated back to vertical, it will land. It can also take off or land normally—for fuel economy and increased range where airfields are available. The plane is powered by an 825-hp Lycoming T-53 shaft turbine engine. Now that ground testing and hovering programs are complete, the Doak 16 will undergo flight tests leading to higher speeds at Edwards Air Force Base. Although designed for army liaison, observation and rescue missions, the manufacturer foresees a commercial use for the plane in feederline service between small airfields and major cities.

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Unit-mounted... All brake parts are mounted on the spider for compactness. Efficiency is higher and correct cam shaft alignment is assured with close coupled cam shaft and chamber bracket.*

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designed for heavy-duty automotive service

Here is a brake that gives longer, trouble-free service for trucks, trailers, and all types of industrial and road equipment. These heavy-duty "P" Series Brakes are easy to maintain in service. Simplicity of design is the keynote—with brake, air chamber, and camshaft all mounted as a unit.

The outstanding features of the Rockwell-Standard "P" Series Brakes give increased economy and performance. Operating temperatures are lower and lining life longer because open-type spiders assure good internal ventilation and rapid cooling. Rockwell-Standard "Econo-liners" are tapered to provide greatest thickness where greatest lining wear occurs.

A constant-lift "S" type cam assures uniform application of brake shoes for maximum control and immediate response. Brake adjustments are quick with easily accessible slack-adjusters. Long wearing nylon bushings assure smooth operation with minimum maintenance.

"P" Series Power Brakes are available in a range of capacities and sizes to fit every need.

*"P" Series Brakes are also available with inboard chamber mounting for special applications.

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Instrumentation for Testing Space Flight Lags

RANDOLPH AFB—Designing instrumentation for testing man's ability to survive flight in space is being seriously hampered by space and weight limitations imposed by such a test vehicle. According to biological research personnel here at the School of Aviation Medicine, the limited techniques available in this field make it impossible to measure all of the physiological variables that are needed for studying small isolated animals. In addition, they say they lack funds to support this phase of research.

"We would like to be able to measure pulse rate, respiratory rate and depth, blood pressure, systolic and diastolic (contraction and expansion of heart cavities), surface body and inner body temperatures, oxygen uptake and CO_2 partial pressures," reports Capt. Ray W. Ware, flight surgeon in the Dept of Physiology and Biophysics. "The measurements we would like to get aren't common, although they can be made in the laboratory."

Because of the weight and space limitations imposed on testing procedures, research in biological instrumentation must be redesigned to conform to existing recording and telemetering systems which process only engineering data. Since these telemetering systems must be used, transducers must be developed or adapted to translate the physiological data, Capt Ware says.

Some progress has been made: the school has developed a respiratory flow sensor to measure rate and depth of respiration. (Most in-flight measurements of respiration to date have been of rate only.) The instrument, like a thermal flow meter is inserted in a person's oxygen mask. The difficulty in attaching to small animals confines its use to humans.

There is also a need for new test methods for measuring both heart rate and stroke volume (cardiac output) but to get the stroke volume with existing techniques, a needle must be inserted directly into the artery which can't be done during space flight. Moreover, new methods for measuring blood flow anywhere in the body are necessary.

In this vein, Dr. Samuel R. Powers, Jr. of Albany Medical College of Albany, NY, has developed an instrument called the Electronic Impedance Plethysmograph which measures a segment of tissue, giving the volume change in circulation, or the rate of blood flow. Since cardiac output presently cannot be measured in flight, the only alternative is to measure pulse rate and blood pressure from which a crude estimate can be made.

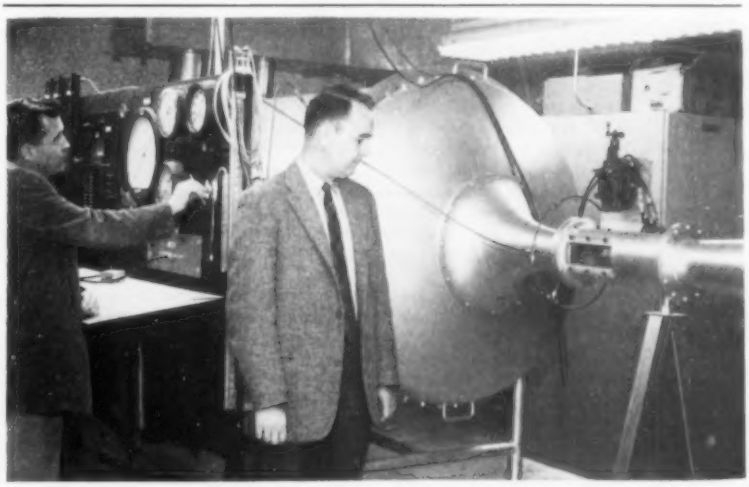
Both systolic and diastolic pressures and pulse rate are needed to get estimation of cardiac output. Pressure is measured through use of a thin plastic cuff which can be periodically inflated with gas. A pressure transducer records cuff pressures while a microphone records sound energy. Sound energy from pulsating blood and cuff pressure are recorded synchronously to get systolic and diastolic blood pressure measurements.

A similar system is being worked on for carbon dioxide partial pressure.

ANIMALS TOTE TELEMETERING

On smaller animals, the scientists are faced with the problem of transmitting the information after a method for obtaining it has been developed, since the animal would destroy wires which are used to convey the information in larger subjects. In one instance, at the School of Aviation Medicine, a small pack consisting of a transistorized telemetering system is attached to the back of the animal to take an electrocardiogram.

Spaceship oxygen sensor . . . developed by Aviation School of Medicine provides oxygen partial pressure in a closed ecological system. Design is based on electrochemical reduction of oxygen at a gold-sensing electrode which produces a potential proportional to oxygen partial pressure with respect to a reference electrode.



A dirty wind tunnel . . . has been developed by the Stanford Research Institute, Menlo Park, Calif., to investigate the problems of high-speed flow of particle-contaminated gases. The tunnel will handle ratios of solids to gas of up to 2 to 1, and for velocities of up to Mach 0.9 through a 3-in. dia throat. Stanford says that aerodynamics theories fail if the ratios of gas weight to particle weight are substantially equal. Differences in the flow of the gas and particles create many problems for which data are not available, such as heat-transfer effects. Available gages are designed for measuring gas flow on the basis of clean or nearly clean gas. Their results with heavy particle content are uncertain, Stanford says.

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THE
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"FLAME SELECTOR"

This new #5522 Harper "Flame Selector" makes "cooking with gas" more than just a cliché implying efficiency. It combines the flexibility of gas flame with the precision of a thermostatic control, eliminating scorching and burning, assuring the same optimum results time after time, once the controls are properly set. Even when serving must be delayed, foods are held appetizingly ready to eat for considerable periods of time. And the homemaker can go about her other tasks, knowing that foods are being cooked right — automatically — and that pan washing will be easy.

The spring supported sensing element makes direct contact with the bottom of the pan. When the pan reaches the temperature selected, the sensing element signals the control valve and from that point on the gas is automatically turned up or down as required by changes in pan temperature. In order to avoid the effects of fluctuating ambient temperatures as a result of heat from other burners in the range, each control contains a special precision compensating element of Chace Thermostatic Bimetal.

Once again Chace provides the precision thermostatic bimetal element on which the efficient operation of a fine appliance may depend for many years, without repair, adjustment or attention of any kind. And once again, we point out that designers and buyers of controls have confidence in our products, safe in the knowledge that a third of a century of bimetal development and processing backs up every pound we ship.

Chace Thermostatic Bimetal is available in over 30 types, in strips, coils or completely fabricated and assembled elements of customer design. Write for 1958 edition of "Successful Applications of Chace Thermostatic Bimetal," containing many pages of engineering data.

IT BENDS WITH THE HEAT

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Back yard . . .
of GM's Florida Test Field is site of thirty 5 by 12-ft panel racks for exposing 5000 individual sample paint panels to outside weathering, and fifteen 50-ft sections under glass for exposing interior fabrics and hardware to sun. Goal is more hardy materials for auto parts.

Auto Parts Get Weather Trials

MIAMI—Materials in General Motors products will henceforth undergo weathering trials at a 10-acre Florida Test Field in South Dade County. The facility replaces a 30-year-old site near Miami's International Airport.

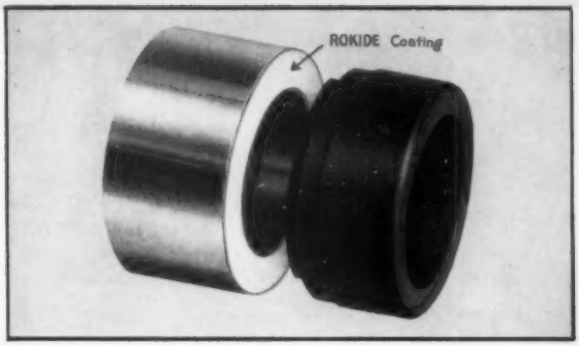
An annex of the GM Technical Center, the Test Field will serve as a proving ground for new ideas, a quality control checkpoint and an aid to the Chemistry Dept. in finding and developing new materials. It will also serve GM suppliers. The Florida location was selected because climate here blends abundant sunshine and rainfall—a combination that is considered especially destructive to auto finishes.

Heart of the facility is its 750 ft of

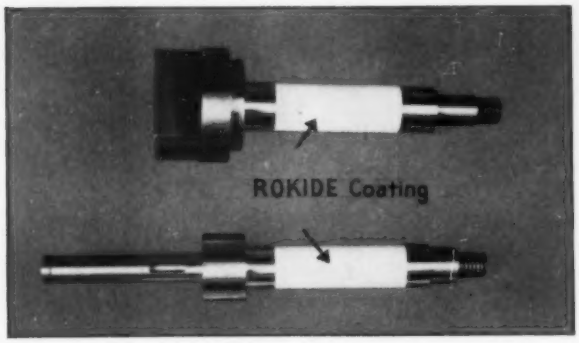
Closeup of racks . . .
shows display of reflectors, lamp lenses, and rubber and plastic moldings—a few of auto parts that GM tests at its new Florida Test Field. When samples satisfactorily endure the sun and dampness of Florida, GM says, they are a safe bet to endure climate anywhere else in U. S.

CIRCLE 59 READER SERVICE CARD

ROKIDE* Spray Coatings Add Life to Many Different Parts



In the upper photo courtesy of the Durametallic Corporation, the arrow shows where ROKIDE coating is applied to Dura Seals developed by this organization for sealing many chemicals. On the ring at left, the ROKIDE coating provides ideal mating with the carbon gland insert at right. This assures a tight, long wearing seal. In the photo below, ROKIDE coatings, indicated by arrows, provide equally valuable wear resistance for parts such as metal shafts.



ROKIDE coatings can be applied to parts of a wide variety of shapes and sizes. These new coatings are produced by heating the end of a solid rod and projecting the molten particles at a high velocity against a prepared surface where they adhere and solidify. Already in use for many military and commercial applications, ROKIDE coatings are also being tested on many other jobs.

Norton ROKIDE spray coatings are hard, adherent crystalline refractory oxides. They protect a variety of underlying materials, particularly metals, with benefits including:

Great resistance to wear, thermal shock and corrosion . . . low friction surface . . . high melting point . . . excellent mechanical strength . . . dimensional stability . . . relative chemical inertness . . . perfect mating for carbons.

The Three Types

ROKIDE "A" aluminum oxide, ROKIDE "ZS" zirconium silicate and ROKIDE "Z" zirconium oxide have proved successful for many uses. For example, in applications involving electrical insulation, electronics, bearing surfaces, erosion protection, corrosion resistance, chemical barriers, material upgrading, surface catalyst activity, general wear resistance and altering emissivity and characteristics of surfaces.

Facilities for applying ROKIDE coatings are maintained at Norton Company, Worcester, Mass., and at its plant 2555 Lafayette Street, Santa Clara, Cal. For the latest ROKIDE Bulletin, write to NORTON COMPANY, 738 New Bond St., Worcester, Mass.

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"Choose from this wide range of Gast Air Compressors", says C. E. Bradley, Ass't. Sales Mgr. "Vacuum Pumps are also available in corresponding models."

Here's high performance . . . in a full line of

GAST rotary vane COMPRESSORS and VACUUM PUMPS

When you select original equipment Air Pumps, look at the Gast Line. You'll see how your product—and budget—may benefit.

Within a well-defined range, Gast Pumps excel on hundreds of product applications. (Capacities .6 to 45 cfm.; pressures to 30 psi., vacuum to 28 in. Hg.) Precision-built primarily for O.E.M. use, they are rugged and dependable. Simple rotary-vane design maintains like-new performance for years, because vanes take up their own wear automatically. Air displacement is positive and pulseless—no air tank needed. Ball bearings and self-adjusting shaft seals keep efficiency high.

Types include: Dual-chamber (one chamber for vacuum, one for pressure), integral-motor pumps, light-duty models for moderate pressure or vacuum, and fan-cooled models for heavy-duty service. Oil-less (carbon-vane) types provide absolutely oil-free air if desired.

Submit your problem for suggestions by Gast Engineers—or . . .

Write today for Catalog on Compressors or Vacuum Pumps. State specific type or capacity that interests you.

(1) (Front to rear) Dual Chamber Pumps:	(2) Integral-Motor Pumps for O.E.M. or Lab use:	(3) Light-Duty Models Moderate Vac./Press.	(4) Heavy-Duty Models, with Fan Cooling, V-belt or Direct Dr.
Model 11 x 1740, total to 23 cfm.	0521, 1/3 hp. to 3.8 cfm.	3040, up to 24.2 cfm.	2565, to 21.0 cfm.
	0321, 1/4 hp. to 2.2 cfm.	1550, up to 15.0 cfm.	1065, to 8.3 cfm.
10 x 1040, to 18 cfm.	0211, 1/6 hp. to 1.3 cfm.	0740, up to 5.6 cfm.	0465, to 4.0 cfm.
Single (In Hand) AD-440, to .6 cfm.	0406, 1/12 hp. to .6 cfm.	0440, up to 4.0 cfm.	4565, to 45.0 cfm.
		0240, up to 2.0 cfm.	

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- VACUUM PUMPS TO 28 IN.

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aluminum racks where materials are exposed to weathering for periods ranging from three months to three years. Just about all vehicle parts that get direct or indirect exposure—plating, upholstery fabrics, plastic and rubber moldings, decorative emblems, locomotive finishes, steering wheels, etc—are tried out here. Tests number about 25,000 annually.

Sample tests include: exposing partially covered upholstery fabrics to the sun under glass (thereby simulating conditions inside an auto) before accepting fabrics for production; depositing iron filings on sample auto finishes. On this test the rusty spots left by the filings suggested changing shipping techniques to protect auto bodies from particles that drop from freight car overhead chains.

The facility also includes building space for photographic dark room, instrumentation room, and a humidity room where a sustained 100 F temperature and 100% humidity will test for mildew.

Support equipment at the Test Field includes phyreliometers to record total sunshine for both direct and underglass exposure. A dewmeter gives hourly records of how long a sample is wet and a spectrolimeter to separate and measure total of sun's individual wave bands from sunrise to sunset.

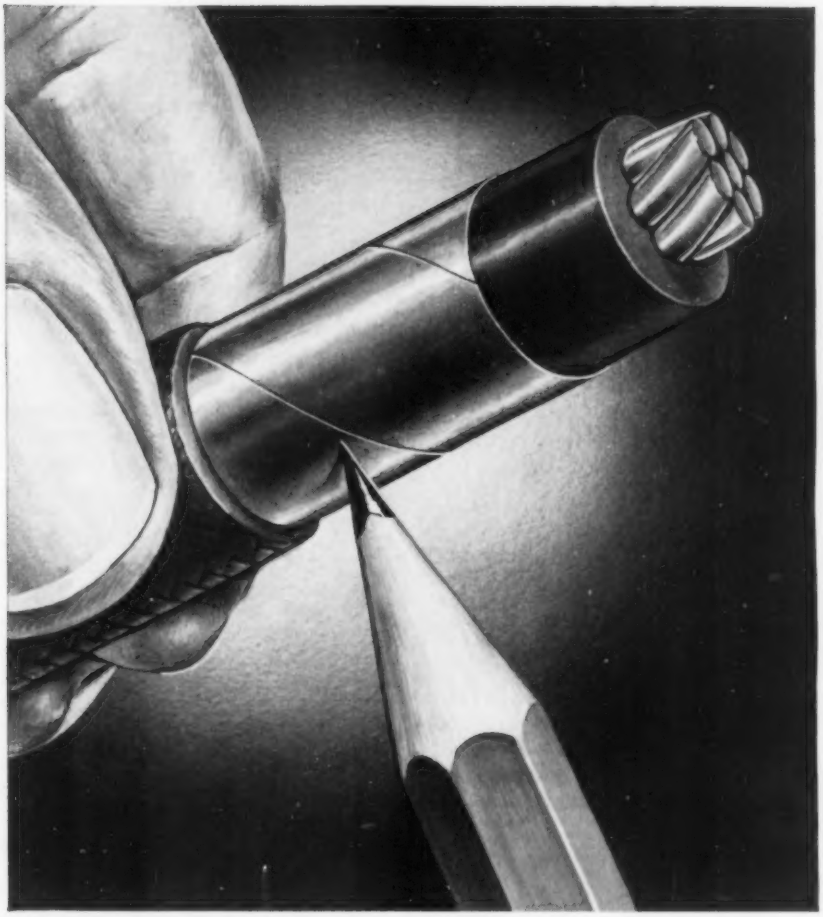
British Propose Reactor Liability Law

LONDON—Private operators of nuclear reactors in England will have to carry insurance up to $14 million liability, or be able to show liquid assets for meeting claims to that amount, under a new bill introduced by the government. (see *US requirements*, Oct 27 *p* 41 and Nov 10, *p* 67).

The bill would require a license by the Ministry of Power before a nuclear reactor could be built and operated, in order to insure control and supervision in the interests of public safety.

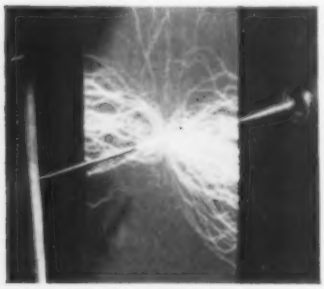
Because of the time-lag in radiation injuries, the bill provides that action for damages can be brought up to 10 years after an accident. Liability is absolute, whether or not the accident can be considered avoidable.

The licensing requirement does not apply to the Atomic Energy Authority



PROPERTIES OF "MYLAR"

"Mylar" offers a unique combination of properties that may help you improve performance and lower costs of *your* product. Here are two of the many important properties for evaluation.



HIGH DIELECTRIC STRENGTH: Average of 4,000 volts per mil . . . average power factor of 0.003 at 60 cycles.

SUPERIOR CHEMICAL RESISTANCE: Unaffected by oils, grease, most acids and alkalis, moisture and solvents.

NATIONAL ELECTRIC REPORTS...

Tapes of Du Pont MYLAR® help improve building-wire performance . . . cut manufacturing costs

PROBLEM: National Electric Products Corp., Pittsburgh, was seeking a higher-quality material to replace rubber-filled cotton tape used in their building wire. At the same time, they were looking for ways to cut manufacturing costs.

SOLUTION: Du Pont "Mylar"* polyester film. *And "Mylar" costs less on a square foot basis than rubber-filled cotton tape.* Tests proved a tape of "Mylar" immersed in water for 12 hours absorbed less than 1% of its weight vs. 32% for rubber-filled cotton tape. Building wire using 1 mil "Mylar" had 4 times the abrasion resistance of wire using 10 mil rubber-filled cotton tape.

RESULTS: Reduced wire diameter and weight. In manufacturing, "Mylar" permits additional savings because reduced cable diameter requires less braided outer covering material. The physical toughness of "Mylar" gives extra safety against damage by flexing, pinching, bending and abrasion. Resistance to moisture and normal atmospheric oxidation is improved.

HOW CAN "MYLAR" HELP YOU? Whether you use heavy duty cable, motors, transformers or miniaturized capacitors, it will pay you to investigate the performance benefits of "Mylar". Component makers find this tough, thin film often costs less on an area basis than present insulation. For detailed information, send in the coupon.

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Film Dept., Room P-11, Nemours Bldg., Wilmington 98, Del.
Please send booklet listing properties, applications and types of "Mylar" polyester film available (MB-11).

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Company_____
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56 details of stainless steel jet engine component brazed in three steps with no distortion or oxidation by Wall Colmonoy . . .

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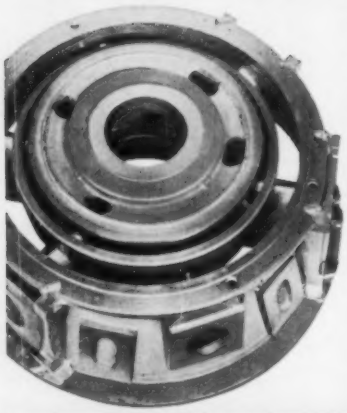

This jet engine diffuser casing is typical of the aircraft and missile parts being furnace brazed at Wall Colmonoy. As originators of Nicrobraz Process brazing, we have an unmatched background in the nickel-alloy brazing of stainless steel and superalloys. Our facilities also include vacuum furnaces for degassing and brazing titanium bearing alloys. Our three plants are ready and able to engineer and process your components. Call or write today.

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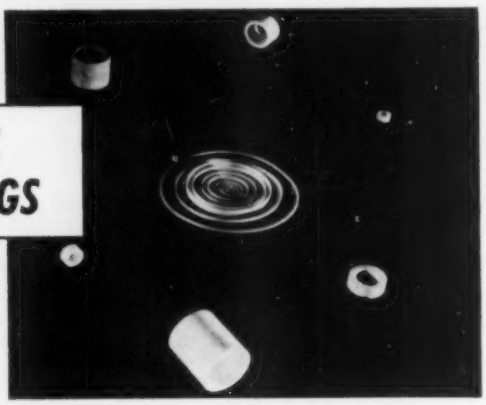
CIRCLE 63 READER SERVICE CARD

FOR SEALS AND BEARINGS



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Compounded to give a coefficient of thermal expansion several times lower than that of pure TFE.

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or to government departments, which are already subject to similar liability except that the amount is unlimited. The bill does, however, affect the government agencies by applying the 10-year period to them, and by extending liability to injuries from nuclear fuel in transit between locations in the UK as well as from radiation at the reactor site.

Insurance premiums are left up to action of the market. British insurance companies have informed the government they are ready to provide the necessary coverage.

The bill applies only to fission-type land reactors, but its provisions could be extended to other plants connected with atomic energy.

NFPA Group Meets

CHICAGO—Standard dimensions and ratings of pumps, valves and cylinders were the theme of many technical sessions of the National Fluid Power Association Meeting held here recently. Industry-wide surveys based on 101 actually completed questionnaires indicate that in hydraulic cylinders alone there are over 100 different available bore diameters ranging from $\frac{1}{16}$-in. to 12-in. dia, including some unlikely values such as $7\frac{3}{4}$ in. and $10\frac{3}{8}$ in. The NFPA hopes that when the survey is published, standards groups such as ASA and SAE might show interest. Or, the users may recognize that simplification is possible, and insist upon it.

Fluid properties was the subject of several sessions. About 97% of hydraulic fluids used are oil or oil derivatives. Chemical fluids and water-based fluids that are needed for fire-resistance and other special characteristics have a limited application and it is felt are not always understood. NEPA is preparing a short education booklet to summarize the status of fire-resistance fluids only.

Bombsight for the B-70

NEW YORK—A bombing and navigation system for Mach 3 B-70 bomber is being developed by International Business Machines Corp's Military Products Div., Owego, N. Y. The system includes a star tracking unit, inertial platform, radar, and a digital computer. A feature of the system is its modular design which will permit in-flight maintenance.

Parts of Coleman stove and lantern made from Chase free-cutting brass rod, or Chase yellow brass tube are vital to the performance of this outdoor camping equipment.

Dependable Coleman Camp Gear relies on parts of Chase® Brass!

Heart of the well-known Coleman pressure-type lantern and the gasoline-fired stove is the generator and the valve body. Both are made of Chase free-cutting brass rod—have been for years. Chase yellow brass tube is also used in Coleman units. They write: "Chase materials are an integral part of Coleman quality."

If what *you* make uses parts machined from brass rod, it will pay you to investigate what Chase free-cutting brass rod can do for you. You will find an ideal combination of all these characteristics:

- **Easy machinability.** Takes heavy feeds and high cutting speeds with short brittle chips.
- **Excellent finished surfaces**—smooth, clean, free from rough edges. Cleaner threads, sharper knurls and a surface that takes polishing, plating, lacquering or enameling with minimum preparation.
- **Outstanding resistance to corrosion**—and copper will never rust.
- **High scrap value** compared with other metals reduces end costs.
- **Longer tool life** gives you increased production at a lower unit cost.

Ask your nearest Chase Representative about Chase free-cutting brass rod for your machined parts. Or write Chase at Waterbury 20, Connecticut.

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are you CREATIVE?

Dr. J. H. McPherson, staff psychologist of the Dow Chemical Co., put together these 27 statements about the nature of creative man. Alongside each statement, Mrs. McPherson (who also has her doctorate in psychology) has added the reaction of a wife who must live with such a man. In tests of engineer and scientist groups, it has clearly separated creative and non-creative men.

Do not attempt to measure your own creativity with the reaction list—give it to your wife and judge yourself by her reaction.

THE PSYCHOLOGIST SPEAKS

The original man seems to prefer the complex asymmetrical, unbalanced, vital, dynamic designs to the orderly symmetrical balanced designs.

A WIFE REACTS . . .

I like the living room to look "balanced", but no — he has to put it all off center.

He feels that a person should have the courage to probe deeply into his feelings, he shouldn't just take things as they are.

He has to understand everything. He talks about his feelings, his thoughts, asks me questions I can't answer. Why won't he let well enough alone?

When caught up in the process of putting ideas together he is apt to be so deeply engrossed that he appears out-of-contact and insensitive to human problems.

When he is in one of his deep periods he'll promise anything and promptly forget about it. Someday I'll fix him.

There is little doubt that most people dislike being confronted with disorder. In individuals who turn out original work in science or in art, however, a reversal of the usual attitude may be observed.

He seems to like a mess. I can't touch a thing.

His universe is more complex and in addition he usually lead's more complex life, seeking tension for the pleasure he obtains upon its discharge.

He seems to like having a problem to solve. Can't he just rest a little bit?

He likes to fool around with new ideas even if they turn out later to be a total waste of time.

Always ideas, some don't work at all. Costs money, too.

He can accept people whose manners and appearance are repulsive to others.

And the people he collects, ugh!

He thinks that some of the rebellious ideas of young people should be accepted and nurtured.

And when John, our 14 year old, has these wild ideas – apt to blow himself up – why my husband laughs and even encourages him!

Original people are also independent in judgment even when put under pressure to conform to a group opinion which is in conflict with their own.

The whole party can come to a nice comfortable agreement and then he'll charge in with something that will upset the apple cart.

He rejects the demand of society that he should shun in himself the primitive, the uncultured, the naive, the nonsensical; that he must be a "civilized" member of the community.

And the way he behaves, sometimes like a barbarian. Why at a formal dinner party he let go with a belch that almost shook the crystal. He was completely unconcerned.

He is likely to have more than the usual amount of respect for the irrational forces in himself and in others.

Like that time when he fell off a horse and instead of getting up he sat and scribbled in his notebook. Honestly!

Creative people are especially observant, and they value accurate observation (telling themselves the truth) more than other people do.

He always points out things to me. He always sees more than I do, sometimes I feel so stupid.

He will suffer great personal pain to testify correctly.

I don't care if it is the president, he says what he thinks is the truth even if it costs him his job.

The creative person seems to have a smaller number of close friends and is never categorized as a "joiner."

Other men join clubs and play golf and relax. Not him. He and one or two of his cronies just sit, talk, drink beer, and fill up the ash-trays.

He is by constitution more vigorous and has available to him an exceptional fund of psychic and physical energy.

When we're at the cottage, he'll bound out of bed, grab his rock bag, head for the woods and then come back bursting with what we should do next, just when I'm tired taking care of the kids and want to rest.

He doesn't seem to value job security as high as others and doesn't mind sticking his neck out at the risk of being blamed or criticized.

I don't think being fired would bother him a bit.

He is more able to be foolish and act like a child at times and here are times when according to most standards he behaves very immaturely.

Sometimes he'll get down on the floor with the kids and act like a child himself — even when we have company. Won't he grow up?

continued

He often seems very gullible because he tends to be open to experience.

A crack-pot will corner him somewhere, he'll bring him home to dinner and you'd think we were entertaining Einstein.

The gullibility that contributes to his creativity may also make him a sucker for unscrupulous people.

He got so excited about a new potato peeler that he bought six. He was going to rig up a device where you pour a peck of potatoes in one end, turn a crank, and get peeled potatoes out at the other.

He seems to be haunted by problems and may feel that he deserves no credit for working on them.

I try to tell him how everybody appreciates his work but he acts like he shouldn't get any credit.. as if it were something he had to do.

He may also tend to talk over his feelings with good friends and really let his hair down recognizing that by doing so he will be able to expend more of his energies toward his creative tasks.

I'd think he could keep a few things to himself.

He is frequenctly unimpressed by titles and other symbols of status success.

We could afford a Cadillac but he's got to keep that old Chevrolet.

He may, in the process of analyzing the kind of work environment that benefits him, devise strange habits that others don't readily understand.

Can you imagine, he says he thinks better out on a hill on the farm. He built a shelter so he can go there in the rain.

He can be a relentless worker when he starts on a project and tends to forget usual social commitments.

We'll plan to go somewhere, have the tickets and everything, the party all arranged, and he'll forget to come home.

Because the solution has not been verbalized, it is difficult for him to discuss it.

Sometimes I'll make the mistake of asking him about his work when he seems depressed. He'll glower and saw the air with his hands and say nothing. Wish I hadn't asked.

He has trouble accepting the usual theological arguments.

Our minister doesn't come to call anymore. Always arguments and the children don't know what to believe.

He seems possessed of a constant constructive discontent, an almost chronic dissatisfaction with things as they are.

It doesn't matter how well somebody's house is built, he can always think of a better way to do it. It's embarrassing at times.

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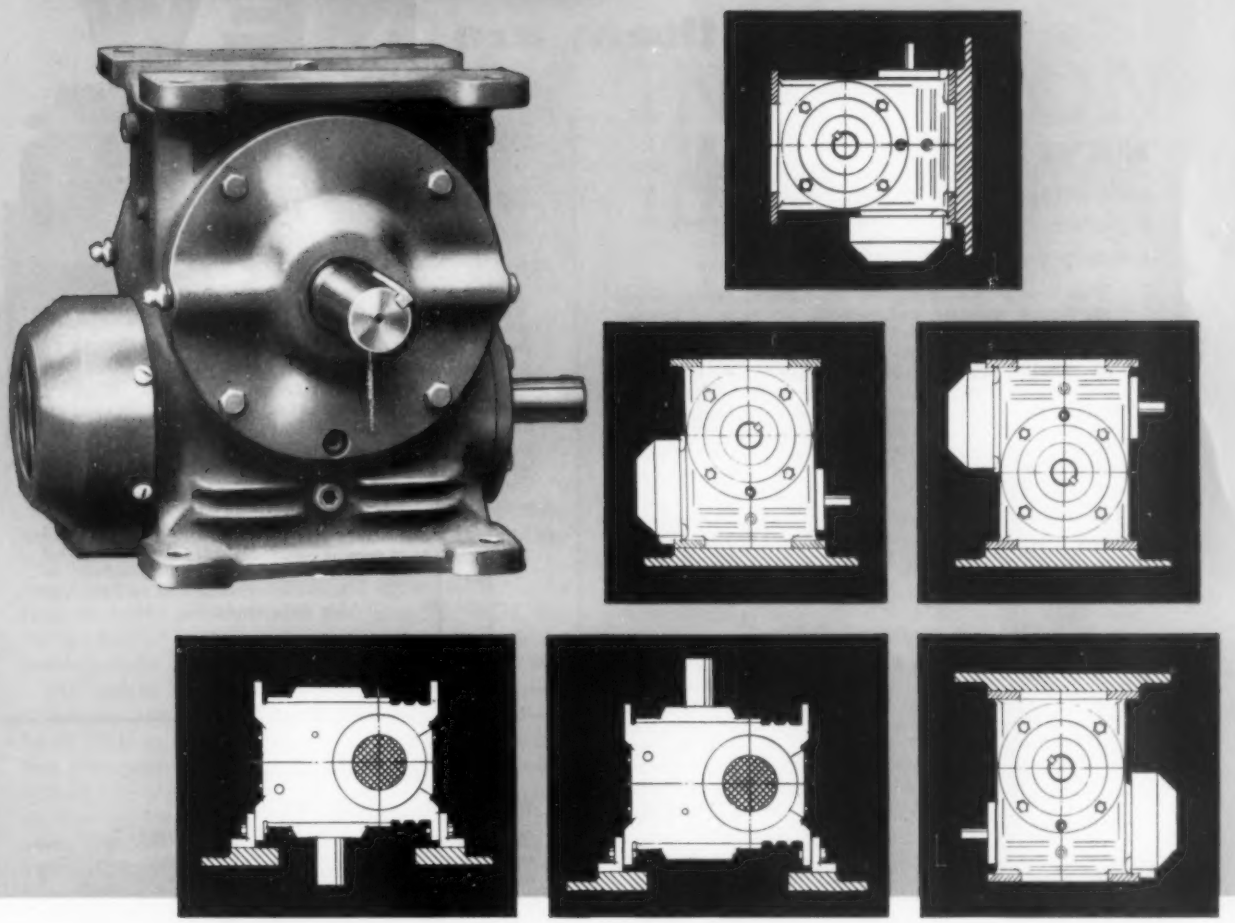

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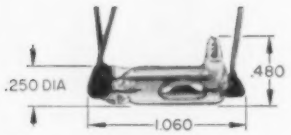

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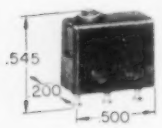
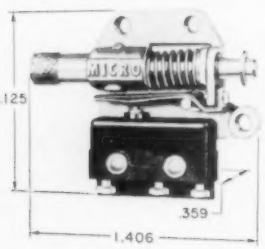


NEW

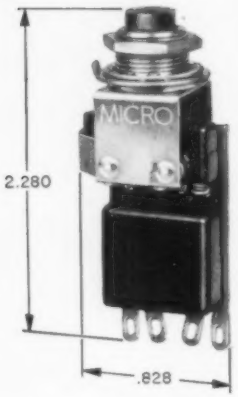
"SX" series sub-subminiature switches

These all-new switches combine extremely small size with "regular size" electrical capacity and excellent reliability. They present a new set of possibilities to the designer of compact devices. 5 amps. 250 vac, 30 vdc. Two mounting holes accept No. 2 screws. Weight—1/28 oz. Ask for data sheet No. 148.



Subminiature door interlock switch 7AC1-T

Cuts off power in equipment cabinets when service door is opened. Manually pulling the rod actuator to maintained contact position closes circuit for checking. When door is next closed, switch returns to normal . . . re-sets itself to safety position. Ask for data sheet No. 108.



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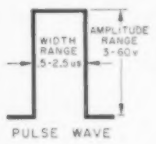
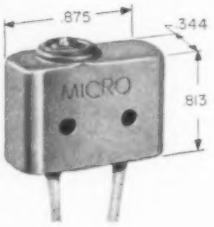
These new switch assemblies produce a one-and-only-one pulse output. Miniature package includes push-button switch and potted one-shot circuit. Eliminates need for designing special pulse input circuits for high speed electronic devices. The square wave pulse width is factory adjustable from .5 to 2.5 micro seconds, and the amplitude from 3 to 60 volts. Both width and amplitude are independent of speed of operation of switch. Ask for data sheet No. 150.



"SE" series environment-free subminiature switches



"SE" Series switches are the smallest and lightest environment-free switches available. Construction is completely sealed. Operate reliably from −65° to +350°F. Pin plunger actuation. Choice of contact arrangements. Rating 5 amps. 125 or 250 vac. 28 vdc—15 amps. inrush; 4 amps. resistive; 3 amps. inductive. Weight—.24 oz. (without leads). Ask for Catalog 77.

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INVENTION in the USSR

How the Soviet patent system works in a land where everything belongs to the state.

VICTOR LOUIS *Moscow Bureau*

"Any invention which the Committee for Invention recognizes as useful can be proclaimed the property of the Republic." This is a direct quote from the first law on inventions in the USSR which was signed by Lenin on June 30, 1919. It makes quite clear from the outset that the product of Soviet men's minds is just as much the property of the state as the product of their physical labor.

The current law divides all proposals into three kinds: inventions, suggestions for technical improvement, and finally "rationalization" suggestions. A recognized invention gets a patent which may be issued only to the inventor himself. It is effective for 15 years, during which time no one may use the invention without the inventor's consent. This rule would apply to the state as well, and so between 1946 and 1956 only one Soviet citizen and 442 foreigners were issued patents.

Alternatively, a certificate of authorship may be issued, in which case all rights to the invention, its manufacture, use and sale belong to the state. The inventor receives an "extraordinary grant" of from 200 to 200,000 rubles ($50 to $50,000 at official exchanges, half that in buying power). Any grant up to 10,000 rubles is untaxed, and this grant is paid to the inventor irrespective of position or post. If a scientist, designer or researcher makes a suggestion which is recognized by certificate of authorship, he receives a grant even if work on the invention was performed on assignment and at the expense of the state.

Outstanding inventors may be granted a special "personal pension" by the state and an invention may even be named after an inventor if he requests it and the committee consents.

Applications for certificate of authorship are free and there are no legal charges in the process. A submitted invention is examined by a commission of experts which reports to the Committee for Inventions on the novelty and usefulness of the suggestion. The committee then decides whether or not to issue a certificate of authorship.

The author has the right to insist that a decision be reached within four months of the date of submission. A rejection may be appealed within a month. An issued certificate may be disputed within a year.

New Law Coming

The chairman of the new Committee for Inventions and Discoveries, A. Garmashov, stated that a new law for inventions is now being drafted: "For the first time in the history of not only the USSR, but the world, a law will be drawn up which guards a scientific discovery and remunerates the labor that has gone into it."

Compensation is stipulated even if application of the idea is delayed, and compensation to authors of rationalization suggestions will be increased. Deductions from the author's compensation, to be used as grants to others who have aided in working out and applying suggestions, will be increased from the present 11¼% to as much as 100% where applicable. This provision is in recognition of the fact that most inventions today are the result of collective work of two or three men, whereas before 1925, 98% of the inventions were by single inventors.

Inventors will be granted additional paid leave and passes to health resorts. The law also will provide for conferring the title "Merited Inventor of the USSR" and presenting a gold medal or "Merited Rationalizer" with a silver medal.

This form of encouragement is very effective and, like the rest of the world, the Soviet Union is intensely interested in encouraging creative men. Last year, 79 new experiment centers were organized to offer suitable atmosphere and working conditions for inventors.

A great number of economically valuable inventions remain unused, probably because of bureaucratic red tape. More than 4000 inventions were not applied in 1956, but those that were netted over 7 billion rubles for the state. ■

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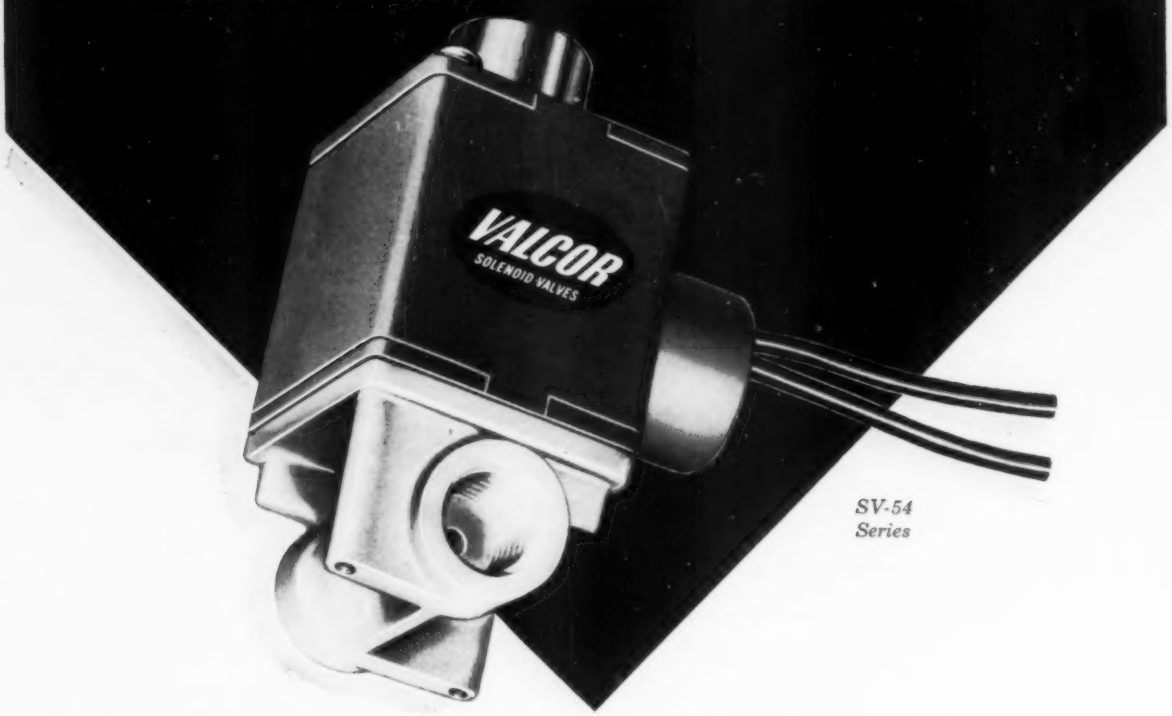

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NEXT REDESIGN PROJECT?

The new crops of graduates, says this leading educator, are coming from engineering schools that teach the way they did 50 years ago. He urges a fresh look—and offers a 3-part program designed to turn out men who can meet the needs of modern technology

DR. ERIC A. WALKER, *president of Pennsylvania State University, speaking at the dedication of the Engineering Center and Research Park of National-U. S. Radiator Corp, Johnstown, Penna., on October 16, 1958. This article is an abstract from Mr. Walker's address.*

. . . ENGINEERING CURRICULA

Engineering tasks were not "projects" 50 years ago; they were just "jobs," and they were performed by men working alone or with just a few intimate associates.

In the town in which I lived as a boy, there was a man who earned his living making small internal-combustion engines somewhat similar to the 2-, 3-, and 5-horsepower engines we now use on our lawnmowers. Although the internal-combustion engine had been invented in the 1860s by a Frenchman named Lenoir, during my boyhood they were still rather crude devices. The man in my town was considered by many to be a scientist and engineer. Today he would probably be considered only a highly qualified mechanic. With the help of just one other man—an aged but competent machinist—this man ran the whole show. He designed his engines, manufactured them in lots of two and three, tested them, and then sold them.

He made good engines. But the total volume of his business was never, I suspect, more than a few hundred dollars at any one time. Further, he knew nothing about thermodynamics. He knew nothing about elasticity or strength of materials. He probably didn't even really understand how his machines worked. But, then, this was typical of science in America at the turn of the century and even later. Science was used to explain how existing things worked, rather than to predict how non-existent things could—or should—be made.

Engineering practices today are radically different from those followed in 1900. The typical engineering project today is vastly more complex, far broader in scope, and much more expensive than was the typical engineering job at the turn of the century.

But how about engineering education? Has it kept pace with this revolutionary shift in engineering practices? Unfortunately, almost no changes have been made in the last 50 years. Engineering education simply has not generally kept pace with progress in engineering practice.

For better communications

The man who built engines in my home town hardly needed to communicate at all. He was the whole show. Today it's not so simple. The engineer today must be able to communicate—clearly, accurately, and concisely—at all

levels and in all directions—even, I might add, in several languages.

His communication almost always has to cut across traditional disciplinary lines so that it can be understood by mechanical engineers, electrical engineers, specialists in acoustics, physicists, chemists, and all sorts of other specialists. Each of these separate disciplines has it own language. To coordinate a modern engineering project, then, the engineer must be able to use the English language—not, I wish to emphasize, the language of his technical specialty, but the *English* language—well enough to explain his work so that it can be understood not only by his fellow workers but also by specialists in quite different disciplines and by management that might be trained in no technical specialty at all.

The engineer also has a responsibility for lay communication. Fortunately or unfortunately, engineers are human beings, and their products are used by human beings. These users must be told how to use the products, how to service them, what to expect from them, even why to buy them. Also, someone must provide the money, the manpower, and the laboratories needed to carry out the project. The engineer will have to furnish them with something they can understand if he wishes his project to be thought about and considered.

Modern engineering practice, then, has greatly increased the engineer's need to communicate. He must be able to communicate to many different publics at many different levels. Yet nowhere in our technical curricula, to my own knowledge, are communications skills really being taught with any effectiveness.

Math, why not composition?

Let me use an analogy with mathematics. After an engineering student has completed a course in mathematics, he is almost never allowed to forget what he has learned. He will have to apply his knowledge in all the other courses he takes, and his success in these other courses will depend, at least in part, on how well he uses the knowledge he learned in the math course. Under this condition, the student develops considerable proficiency in the use of mathematics as a tool by the time he is graduated.

But how about composition? The student almost always must take freshman composition. But once the course is out of the way, he promptly forgets all that he learned. Is he ever penalized for this forgetfulness? Of course not. His professors might at times complain generally about the incoherence of the papers they get from their students, but they never do anything about it. It's not surprising, under these conditions, that the average engineering student fails to learn to write well. In fact, it is surprising that most of them learn to write as well as they do. And we cannot expect much improvement until the faculties of our schools of engineering insist upon decent, workmanlike prose from their students, just as they now insist upon a certain proficiency with mathematics.

Broad-gage thinkers for modern science

The increasing size of modern engineering projects, their increasing complexity, and the rapidity with which theory is today reduced to practice all emphasize yet another need for change in engineering education: the need to broaden drastically the base of fundamental scientific training for at least our brighter engineering students.

Today we make tremendous demands on the men upon whom we depend for the ideas. The designer of a guided missile must not only know something about aerodynamics, but he must also know thermodynamics and fuel combustion, electromagnetic waves and mechanics, servomechanisms and computers. In fact, he must have at his fingertips, if not in his head, the answers to complex technical questions in almost all the fields of scientific inquiry.

He can obtain this knowledge only through an understanding of a wide range of basic science. Engineering has simply outgrown, at its top echelons at least, the narrow specialist. Although specialization may bring an intensification of knowledge, only generalization will provide the inventor with the ability to span the range of knowledge he must be able to understand. The time has come, it seems to me, when we must stratify our engineering education in order to provide a proper educational background: (1) for those who will conceive and direct our large engineering projects, (2) for those who will solve the middle problems of design and engineering, and (3) for those who will carry out the more clearly defined jobs of construction and testing. The traditional four-year bachelor of science program in engineering is ill constructed for providing us with engineers in either the first or the last category.

Education matched with ability

This situation clearly indicates, it seems to me, that we must restructure our engineering education to provide three levels of training: (1) the two-year technical institute to train people for the routine jobs of testing and construction, (2) the regular four-year program for training those who will carry out the design and engineering problems, and (3) the seven-year doctoral program to prepare those capable of becoming inventors and managers.

These should be separate, distinct programs especially designed to meet the particular aims and objectives of each type of training. Each has quite different objectives and quite different purposes, and should be designed with these different objectives and purposes in mind. Today, the bachelor's curriculum is designed as a terminal program. It is complete within itself. The student may elect, however, to superimpose some "graduate" work on top of it to qualify for the doctor's degree. The doctoral program, then, is not an integrated program designed to satisfy its own objectives and purposes. Rather, it is designed as a supplement to the four-year program.

But is the terminal bachelor's program the best possible preparation on which to base the last three years of graduate work? I don't think so. For those students capable of becoming inventors and managers, we need to devise a special program that will provide a broad, interdisciplinary base upon which to erect the intensive specialization of the last three years. We need a program that will instill the love of scholarship and teach sound practices of abstract thought. We need a program that will provide our future managers with the socio-humanistic studies necessary for dealing effectively with people under their direction. We need a program that will challenge them intellectually. I don't believe the usual four-year engineering program provides these things. ■

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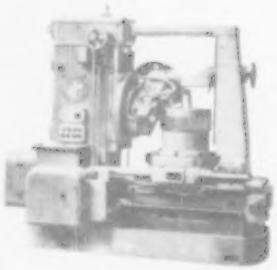
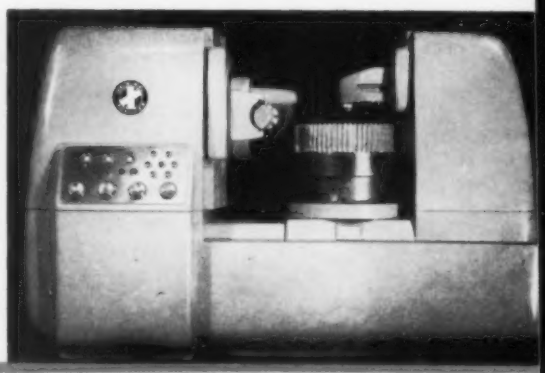
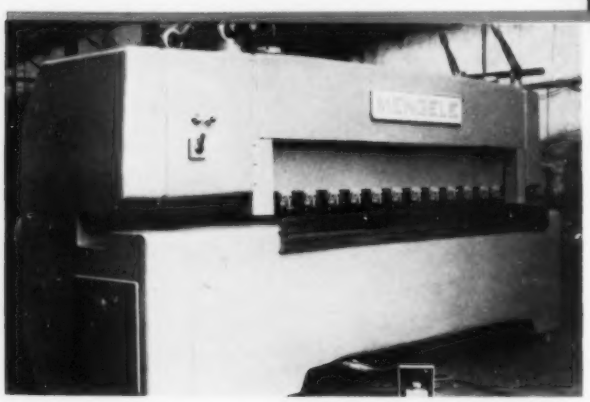
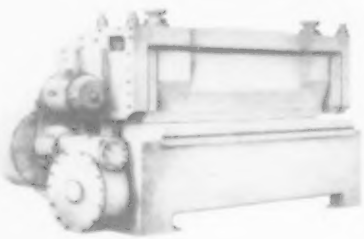


Gear hobber, right, designed by Walter M. Kersting for Pfauter, has all parts but tools themselves enclosed in panels held in place only by extruded rubber gasketing which also soundproofs, seals, and isolates vibration. Former model is at left. Crank-type shears for sheet metal below, redesigned for Mengele now has all drive elements enclosed. Kersting suggested re-arrangement of these parts, choosing smaller but wider flywheel, re-positioning clutch in its center, and then using flywheel as V-belt driven pulley. Former model below at right.





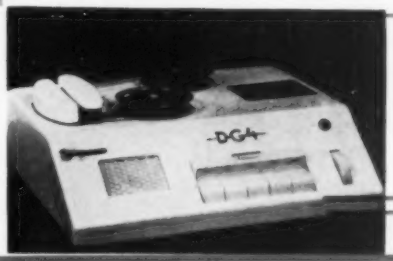


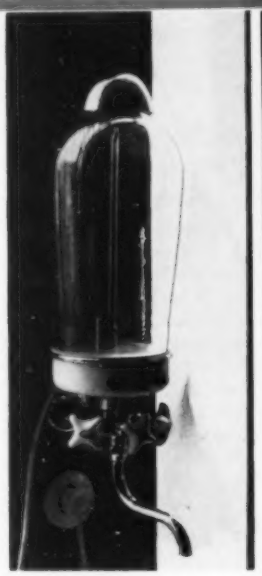
Level-luffing harbor crane at left and below, by Krupp-Addelt, has straddled legs for added strenght and steadiness. Glassed-in operator's cabin has been projected out of the motor room to afford clear up-and-down view. Excavator, at right, has 14-cu-ft capacity. Operator's cab is completely enclosed with good visibility up, down and both sides. Made by Liebherr.

Table model radio-phonograph at right, made by Max Braun Works, has transparent cover and wrap-around housing of white lacquered sheet metal, with natural elm ends.

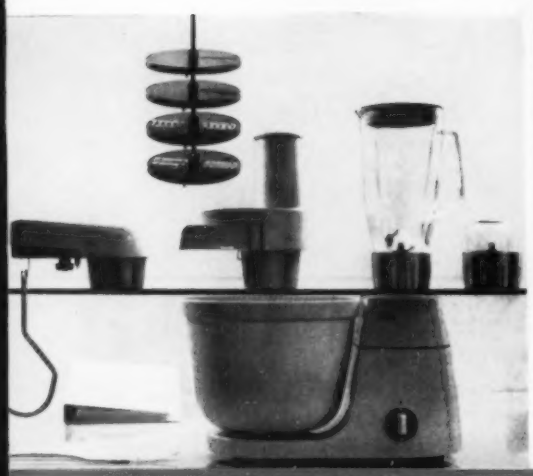
. . . GERMANY

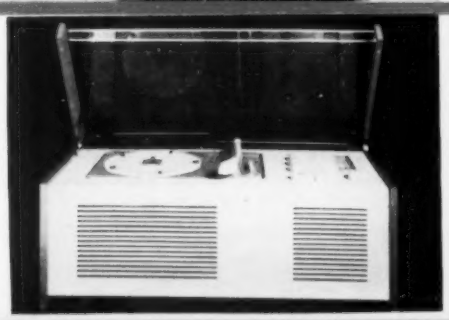
Tape dictation machine made by Apparetebau Stellingen illustrates how German designers are participating in the trend towards more integrated, flowing lines. Former model at right.





Wall-mounted electric water-heater is typical of this widely used European device. Food-mixing machine, below, has various attachments.





he task of the industrial designer, as seen by Prof. Walter M. Kersting (above) one of Germany's leading industrial designers, is to make the technical civilization which surrounds us more acceptable. This branch of art attempts to put highly engineered, mass-produced, often power-driven articles into shapes representing a functionally artistic conception.

Attempts to do this in Germany date back even further than in the USA. A book published in 1932, *The Living Shape*, shows examples of good design stemming from the Cologne Work School, established in 1927. This book contained pictures of what probably was the first alligator type of hood for autos. This became a reality in the USA about 10 years later, but was only adopted in Germany a few years ago.

This slowness is typical of the German manufacturer and consumer, and reveals one of the difficulties faced by the German designer, according to Prof. Kersting. Germans are much more encrusted with tradition than Americans, and like many other Europeans, they generally only accept the new, and seldom actively prefer or demand it.

In addition, durability and dependability must still play a most important part in the German consumer's choice of products. Manufacturers, as a result, are themselves convinced of the importance of such factors in their products. They are generally satisfied with a normal replacement rate for their products, and as a result see little necessity for taking chances with redesigning and the related costs of retooling. Of course this does not mean that Germans always spend their money wisely. Not too long ago, radios were judged by their weight, and as a result some manufacturers actually built sheets of lead into their sets. Still, the more modern-looking consumer goods are slowly becoming preferred.

This trend was even more difficult to bring about with capital goods and industrial equipment. At first, the manufacturers and even some of the professional engineering societies insisted that the industrial designer was not needed for this heavy equipment. It could be left to the engineer, provided he was given a few evening lessons in industrial design.

Today, it is generally accepted that the German industrial designer should be prepared for his work in special schools, with an engineering background required for admittance. One of these is the Ulm School of Design. Such schooling produces graduates able to predict the effects of any alteration they may suggest on a product's performance.

Prof. Fritz Eichler, chief designer of the Max Braun Works, Frankfurt, is convinced that he and his colleagues are beginning to catch up with their American counterparts. Eichler reports that, just as in the United States, too often a manufacturer will approach the problem of product design in the spirit of Hollywood, buying the name and reputation of a well-known designer for its added publicity value.

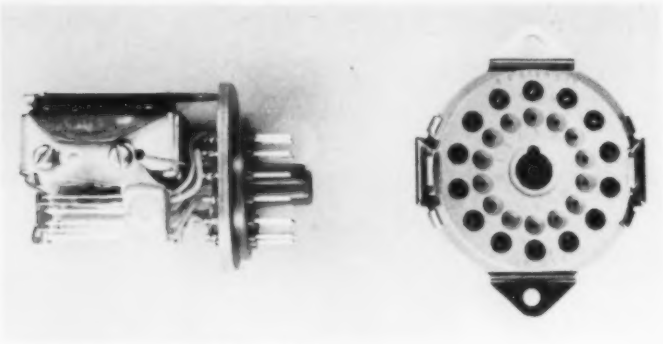
Although German designers are not as well organized as Americans, they are among the leaders, compared with the situation in other European countries. One weakness typical of the present German situation is the lack of satisfactory facilities for small businesses, at costs they can afford. This situation is likely to be rapidly improved, with the help of the "Rat Fuer Formgebung" (Industrial Design Council), established six years ago. The Council is composed of industrial designers and engineers, leading men from industry, commerce and the various schools concerned with this field.

SIGNIFICANT COMPONENTS

Porous-metal filter elements . . .

constructed from metal powders and fibers, filter liquids and gases at temperatures of —420 to 1500 F, depending upon metal used, in system pressures to 10,000 psi. Theoretical average pore size ranges from 10 to 60 microns in a wide range of metals and alloys. Manufacturing process enables finished filter elements to be fused together and, thereby, to withstand extreme thermal shocks. Integrally welded contour ribbon, metal-edge filter elements can be obtained plain or coated with a thin facing of powdered or fibrous metal for a finer degree of filtration. Available in cylinders, disks and other shapes, with rated pore sizes of 25 to 500 microns, for temperature and pressure ranges similar to those for fibrous metal. Prices depend upon specs and quantity. For example, prices for an 18-in.-long filter (of 304 stainless steel) with 36 3½-in. convolutions and standard end caps, containing 5 plus sq ft of effective filtering surface area, start at $125, or about 11¢/sq in. Delivery of standard units, in about 2 wk. **Purolator Products Inc, Rahway, NJ.**

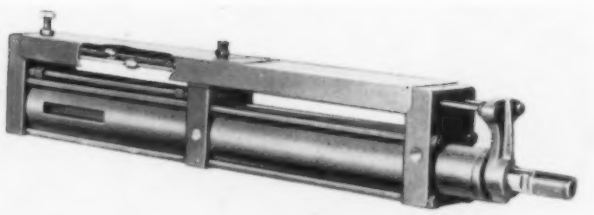
Circle 12, Reader Service Card



Miniature sealed relay . . .

for industrial applications has 14-terminal header with keyed guide post that mates with heavy-duty, mica-filled phenolic socket. 4PDT relay is said to have life of up to 100 million operations at reduced contact loads. Relay uses heavier industrial-type pins and sockets, push-on disconnects and optional panel or bulkhead mounting. Creepage is ¼ in. min. Available in ratings up to 5 amp at 28 v dc or 120 v ac. Basic relay is offered with dc coils, and forms with integral rectifiers are available for 115-v, 60-cps operation. Withstands instantaneous voltage surges to 1500 v without failure. Unit, exclusive of socket, weighs about 5 oz. Measures 1.5 x 1.6 x 2 in. high, exclusive of leads and keyed guide post. Operating time with normal voltage applied to coil is 25 millisec max and release time i s5 millisec max. $9 each in lots of 100. Small quantities from stock; large quamitties in 3 to 4 wk. **General Electric Co, Schenectady 5.**

Circle 11, Reader Service Card



Air-hydraulic unit . . .

has built-in bypass valve with traveling rods that permit rapid advance to any point in stroke, controlled feed rate for any distance, pickup to rapid feed and return to controlled rate. Two movable cams make it possible to set up any combination of fast, slow and skip feed strokes. Cycles can be repeated during stroke by setting bypass valve cams. Controlled feed is during outward stroke; inward stroke has continuous fast feed for rapid retraction. In 2 and 3-in. bores and 2, 4, 6 and 8-in. stroke lengths. The 2-in. bore gives thrust about three times' air line pressure; 3-in. bore gives thrust seven times' air line pressure. Priced at $11; delivery in 3 wk. **Electro Mechano Co, 261 E Erie St, Milwaukee 2.**

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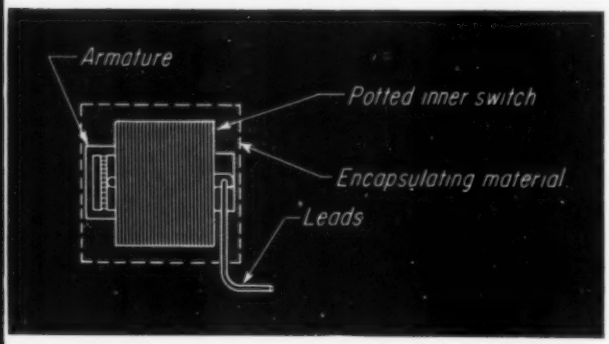

Explosionproof proximity switch . . .

is available in either normally open or normally closed models, for counting, actuating applications in dangerous or corrosive conditions. Presently available in series of sizes ranging from a ¾-in. cubic model for up to 50-amp, continuous duty (up to thousands of amps on one-shot basis), to 1 x 1 x 2 in. for 100-amp continuous duty. Costs considerably less than other proximity switches; available 30 days after receipt of specs. **Reed Research Inc, 1048 Potomac St, NW, Washington 7, DC.**

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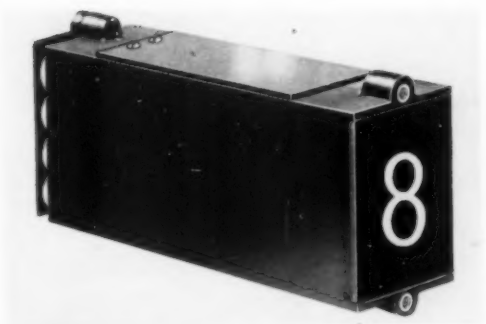
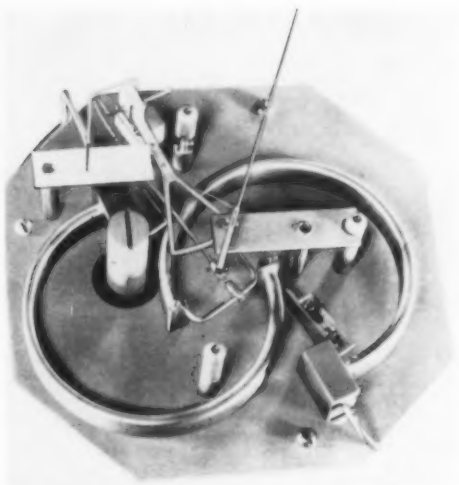


Single unit displays 0-to-9 . . .

digits on one plane. All numbers and/or characters appear on front surface, according to which lamp is actuated. Units are available with shifting decimal point, plus, minus, ac, dc. Rated life of lamps is 3000 to 10,000 hr, depending on voltage used. Lamp replacement is made at rear. Display is purchased as single unit and assembled in groups, presenting continuous surface. Individual viewing screen is 1½ x 2 in. Price of single unit, $15.50. **Industrial Electronic Engineers Inc, 3973 Lankershim Blvd, Hollywood, Calif.**

Circle 15, Reader Service Card



Dual bourdon-tube gages . . .

are interconnected by ratio linkage to permit measurement of absolute and differential pressures to 500 psi. System pressures are admitted to inside of corrosion-resistant tubes, never to gage case. For absolute pressure work, one tube is evacuated and serves as zero pressure reference. For differential pressures, each system pressure is connected to a separate tube. Temperature effect is said to be virtually eliminated and ratio linkage provides negligible friction and hysteresis Accuracy is said to be better than 0.2% of full-scale range. Pressure measurements are read directly from custom-calibrated dial. Ranges for absolute or differential-pressure models are 0 to 30-psi min to 0 to 500-psi max. In aluminum case, weighs about 8 lb. Absolute models are $395; differential units, $345. Delivery ranges from 2 to 4 mo, depending upon model. **Wallace & Tiernan Inc, 25 Main St, Belleville 9, NJ.**

Circle 16, Reader Service Card

Iron powder metal bearings . . .

are said to cost considerably less than comparable bearings now made from porous bronze, through service and life tests indicate performance equal to porous bronze—and ability to withstand higher temperatures. Can be used where corrosion is not a problem and mechanical strength requirements are within tolerable limits. Ultimate tensile strength is 10,000 psi; compressive yield point, 9500 psi. Oil content is about 20% by volume. Bearing will also operate without oil for short periods. Available in sleeve, flange and spherical form in production quantities. 2 to 3-wk delivery, depending upon size. Free sample of a 1-in. ID x ¼-in. OD x 1 in. long bearing is available. **Chrysler Corp, Amplex Div, PO Box 2718, Detroit 31.**

Circle 17, Reader Service Card

SLIP RING ASSEMBLIES

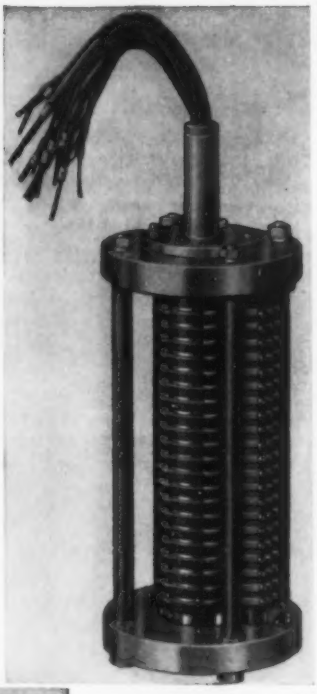
BRUSH HOLDER ASSEMBLIES

BRUSH CONTACTS

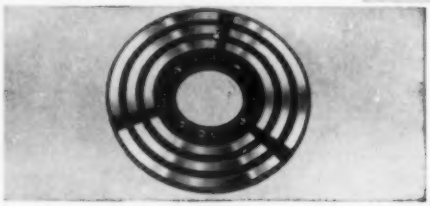
- *DESIGNED FOR YOUR APPLICATION*
- *BUILT TO YOUR SPECIFICATIONS*

A long, close acquaintance with this field enables the Superior staff to offer slip ring assemblies and components individually designed for all applications, such as:

SIGNAL CIRCUITS
POWER CIRCUITS
SEGMENTED COMMUTATORS
SPECIAL BRUSH BLOCKS
COMBINATION SIGNAL AND POWER CIRCUITS

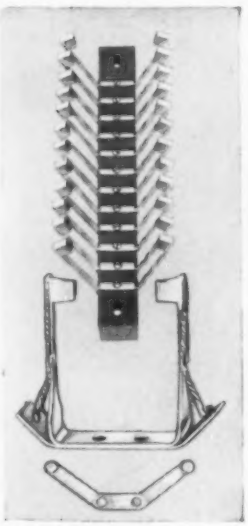


Basic drum-type assembly with 24 rings.



Basic pancake-type assembly with segmented rings.

Brush block assemblies, cantilever type.



Space, insulation, noise requirements, and contact composition, and other problems have received our special attention. Superior makes brush contacts, brush holders, rings, all the components — *in one package.*

★ ★ ★

Brush holders can be designed around existing ring assemblies. Even brushes alone can be supplied to fulfill a specific customer need. The brush is the vital link in the entire assembly. Our experience in this area alone has developed a range of brush grades which will withstand any conditions and give optimum operation. In addition to our regular production facilities, we maintain a special Pilot Run Department.

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SIGNIFICANT COMPONENTS
MATERIALS
PROCESSES . . .

Copper alloy rod . . .

is recommended for parts or components that require excellent machinability characteristics as well as excellent thermal and electrical properties. Said to have machinability rating of 90; electrical and thermal conductivity of 96% that of OFHC or ETP copper. Also said to have excellent hot-working characteristics for forging and pressure and, at same time, cold-working and corrosion resistance characteristics comparable to pure copper. Finished in copper color and can be electroplated with no tarnishing of tin or silver plates. Tensile strength of round rod, in soft and drawn tempers, 1 to 2 in. dia, ranges from 33,000 to 53,000 psi. Yield strength in this range, 0.5% extension under load, is 11,000 to 50,000 psi. Melting point is 1980 F. May be fabricated by machining, hot-forging and pressing, roll-threading, knurling, heading and upsetting, forming and bending, squeezing and swaging. $0.562 per lb (5000 to 10,000 lb). 5-wk delivery. **Scovill Mfg Co, Mill Products Div, Waterbury 20, Conn.**

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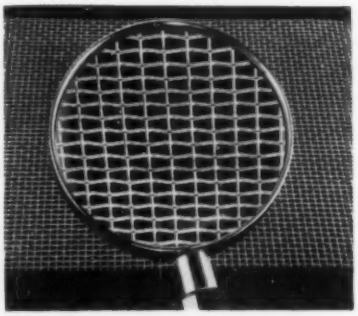

Brazed wire cloth . . .

prevents shifting of the wires in installations where the material is subjected to severe vibration. 8 x 8 mesh is woven from 0.020-in.-dia T-304 stainless steel wire; cloth is copper brazed at each intersection after weaving. **Cambridge Wire Cloth Co, Cambridge, Md.**

Circle 19, Reader Service Card

Solvent-resistant grease . . .

is said to be impervious to washing action of a wide range of petroleum, coal-tar and chlorinated liquids. Permits normal lubrication of pumps, bearings and sliding surfaces that must work in presence of solvents and liquid fuels. Prices range from $2.95 to $2.45 per lb for 5- to 400-lb containers. Less than 200 lb, FOB Cleveland. Shipped within 48 hr. **Pennsylvania Refining Co, 2686 Lisbon Rd, Cleveland 4.**

Circle 20, Reader Service Card

Feel that clean, burr-free edge; it's sheared on a DI-ACRO SHEAR

Photo shows a 16 gauge mild steel sheet sheared on a Di-Acro Vari-O-Speed Powershear No. 24—no sheet distortion.

"We hold tolerances of ± .002" with our Di-Acro Shear," reports Richard Hodges, foreman at Consolidated Electrodynamics Corp., Pasadena, Calif. Manufacturing precision electronic equipment, they work with a variety of sheet materials—fish paper, beryllium copper, phosphorous bronze, hot and cold rolled steel, aluminum, etc. "Parts must be burr-free—require no milling for a 'light-tight' fit."

• • • •

The Di-Acro Vari-O-Speed Powershear will shear up through 16 gauge mild steel, ⅛" in some aluminums, plastics, rubber and many other sheet materials—accurately cut strips less than .025" wide. Speed rivals that of big machines. No skills required—women can operate it.

Available in two power models in 12" and 24" widths and four hand operated models 6" to 24" wide. "Quick-Set" Micrometer gauges are standard on power models, accessories on hand operated shears.

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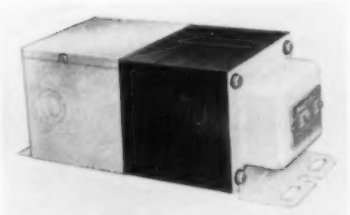
di-acro PRECISION METALWORKING MACHINES
333-8th Ave., Lake City, Minnesota

CIRCLE 71 READER SERVICE CARD

Image converter camera . . . designed around electrostatically focused and deflected image-converter tube, is intended for study and photography of transient phenomena in microsec range. Exposure times to 10 millimicrosec are possible. Streak periods of 10 to 200 microsec available with accessories. Features multiple frames, independently controlled and continuously variable frame spacing and a steady picture that can be displayed for setup. In normal operation, there is no light loss and, with proper light source, light gains may be obtained. Camera may be used for shock tube studies, hypersonic ballistic studies, detonation processes, explosive processes, electrical discharge phenomena, transient spectrographic analysis or magnetohydrodynamics. **Precision Technology Dept, Librascope Inc, 66 South P St, Livermore, Calif.**

Circle 21, Reader Service Card



Constant-voltage stabilizers . . . incorporate automatic overload or short-circuit protection when load current is increased in excess of normal operating load. Voltage fluctuation is said to be corrected in ½ cycle or 1/30 sec. Output voltage stabilization is obtained by a parallel combination of fixed capacitance and magnetic core inductance to provide required variable capacitive current. Standard units perform within 1% of stabilized nominal output voltage even with input fluctuating 30% from nominal at ambient temperatures of 77 to 80 F. Line includes units for 190 to 260-v input and 95 to 130 v-input circuits. Also, in addition to standard 120-v and 240-v outputs, units are available for 6.3-v output. Capacities range from 15 to 2000 va. **Acme Electric Corp, Cuba, NY.**

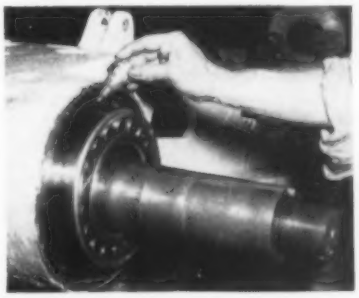
Circle 22, Reader Service Card

Miniature piston . . . is squib-actuated by as little as 100 ergs at 1.5 v or 0.2 amp. Capable of providing 20-lb thrust over a ⅛ to ⅞-in. stroke within 1 millisec elapsed time. Functions in temperatures of −65 to 165 F and withstands 20,000-g shock and acceleration. Shelf life is said to be measurable in years. Dimensions are ¼ in. dia x 1⅛ in. long. **Atlas Powder Co, Wilmington 99, Del.**

Circle 23, Reader Service Card

"WE REPLACE 9" BEARINGS IN LESS THAN AN HOUR... INSTEAD OF 3 TO 4 DAYS- AND SAVE $155.00 EACH"

Says David B. Cook, Jr., President Acme Road Machinery Co., Inc. Frankfort, New York



"Replacing 9-inch bearings in the jaws of a giant rock crusher once required days to bore the housing and build up weld metal for reboring to a .0015" interference fit. Even then, placing the bearing took two men 3 or 4 hours.

Now, thanks to LOCTITE Liquid Sealant, we prepare the housing, clean and insert the bearing with a slip fit in less than one hour! Crusher jaw bearings locked in with LOCTITE have been in rugged service for many months without report of a single failure."

You, too, can eliminate interference fits. LOCTITE hardens between bearing and housing to form a bond that exceeds any interference fit . . . requires no heat or mixing.

Write for further information on money-saving LOCTITE applications in production or service . . . for slip fitting bearings, bushings, hardened sleeves and rotors on shafts; for locking threaded fasteners or studs securely; for sealing against high-pressure fluids.

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119 Woodbine St., Hartford 6, Conn.
In Canada: J. S. Parkes & Co., Ltd., Montreal

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GRIT • FUMES • IMPURITIES

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COUNTER
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in MISSILES and INSTRUMENTATION

only ELECTRICAL IMPULSES (for counting and reset) enter this PROTECTIVE CASE

only 3-1/2" wide x 1-7/8" deep x 3-7/16" high

. . . and FAST*

* Speeds up to 1500 CPM with maximum resetting time of 105 milliseconds

Designed for use on military and industrial applications where adverse operating conditions exist. Compact and sturdy with Winchester hermetic seal connector on bottom for quick electrical connections. Large, easily-read figures — white on black background. Operates on 28 V. DC — other voltages available on special order. Finished gray or standard military.

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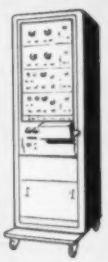
BODINE MOTORS

give UNIFORM PERFORMANCE



"Motors used in our Oscillographic Recording Instruments must (1) give uniform performance, (2) run at a constant speed, (3) run quietly, and (4) be dependable with a long life. Bodine motors meet all these requirements."—Sanborn Company.

Call in a Bodine engineer in the early stages of your product planning. You may find one of Bodine's 3500 standard motors perfectly suited.

6 to 14 week delivery on built-to-order motors!

Fast shipment on 265 different STOCK types and sizes.

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. . . wondering where to turn for top-notch plastics moldings? Need help in new designs? Look to Chicago Molded. You'll find top-rank engineers and designers . . . facilities for volume production of anything up to the largest parts made . . . over 39 years of experience—*at your service now.* Just call:

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50,000 die-cast parts daily . . .

becomes possible with a forming process that is said to combine basic advantages of investment casting with those of coining, cold-forming, screw-machine production and similar methods. All castable metals and alloys can be used, achieving dimensional tolerances as close as ±0.001 in. per in.; cross-sectional thickness as low as 0.020; surface finish of 30 to 50 microin., depending on alloy, and configurations. Parts can be produced at cost lower than possible with methods where secondary operations are necessary. **Casting Engineers Inc, 2323 N Bosworth Ave, Chicago 14.**

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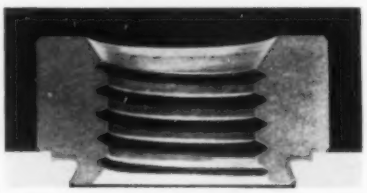


Thin-section fastener . . .

can be firmly anchored in sheet as thin as 0.020 in. or as thick as 0.250 in. or more. Load-bearing, female-threaded swage clinch nut can be installed in steel, brass, Monel, aluminum and similar metals with installation pressures as much as 50% lower than previously necessary. Can be swaged into sheet metal with Rockwell C-scale hardness of 25. Cylindrical nut has annular neck or swage ring that drops into hole stamped or drilled into metal. Nuts are said to be strong enough to break 160,000 psi bolts before failing; require no special tools; mount flush on the load side of the nut. Available in screw dia sizes No. 2 through ¼ in. Threads are Class 2B. **Standard Pressed Steel Co, Jenkintown, Penna.**

Circle 25, Reader Service Card

Fibrous heat insulation . . .

blocks heat penetration by scattering incoming infrared rays. Called fibrous potassium titanate, material is a compact mass of crystalline fibers, less than 1/25,000 in. dia and highly reflective. In the 1300 to 2100-F range, it is said to be about twice as effective on a volume basis as any known insulating material. Blocks, can be formed into any shape while wet. After 6 days aging at 1900 F, blocks are said to have shown no dimensional change. Currently available as loose fibers, loose fill, blocks of varying densities, mats of

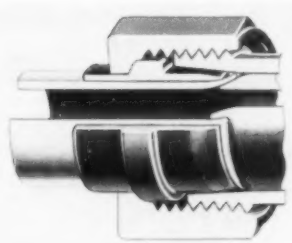
various thicknesses and as "lumps." Also available is a material which can be spread like mortar when combined with water. Suitable as thermal insulation in rockets, aircraft, atomic-powered vehicles. **E I du Pont de Nemours & Co Inc, Wilmington 98, Del.**

Circle 26, Reader Service Card

Silicon solar cells . . .

are capable of converting 10% and higher of radiant energy. Rectangular cells are available for commercial and military applications and are capable of providing output of about 9 w per sq ft of active cell area in bright sunlight. New alloying techniques permanently bond contact to silicon wafer, making contact an integral part of cell itself, while still allowing soldering of individual cells. Individual cells are offered, with or without color-coded pigtail leads, in sizes ½ x 1 cm, ½ x 2 cm and 1 x 2 cm. **International Rectifier Corp, 1521 E Grand Ave, El Segundo, Calif.**

Circle 27, Reader Service Card



Self-flaring tube fitting . . .

employs a hardened steel sleeve to press tube into contoured body to form a flare as fitting is tightened, effecting a pressure-tight seal on OD and ID. Slotted skirt on sleeve rear supports tube, absorbing excess vibration. Overtightening is prevented by design and fitting may be reused without danger of leakage. Offered in all standard tube sizes from ⅛ to 2 in. and in all common styles. Materials available include steel, stainless steel, brass, aluminum. **Flodar Corp, 16911 St Clair Ave, Cleveland.**

Circle 28, Reader Service Card

Pocket adding machine . . .

for engineers and anyone else who must figure in feet, inches and fractions. Conversion capacity is 9999 ft to 11⅞ in. Measures 6⅛ x 1½ in. and weighs 3 oz including leather carrying case. Brass outer case with embossed and recessed figures has dark green-backed enamel and satin gold finish. Guaranteed for 12 mo against defects. $4.95. **Alexdraft Equipment Co, Dept PE, 642 N Chester Ave, Pasadena, Calif.**

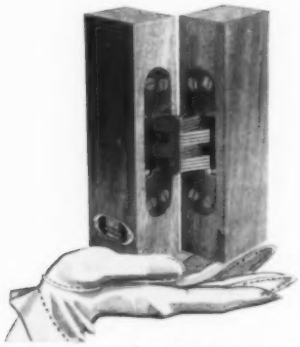
Circle 29, Reader Service Card

Chances are it will be equipped with—SOSS INVISIBLE HINGES

"The Hinge That Hides Itself"

Soss Invisible Hinges enable you to do a better job whether you're designing a rocket to the moon or a new typewriter.

NO PROTRUDING HINGE BUTT



Soss Hinges are completely hidden from view when doors or lids are closed. They are the only hinge that creates the flush, smooth streamlined surfaces so necessary for modern design. Unique Soss Hinges are available in a wide size range to meet every requirement.

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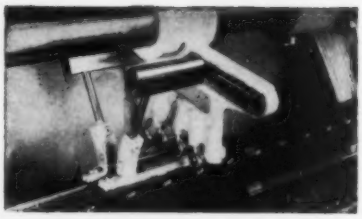

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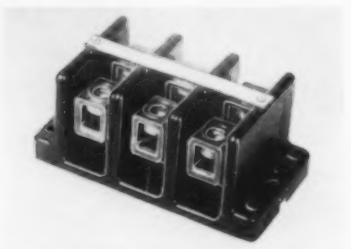

Sectional terminal blocks . . . for high-pressure, solderless connection with heavy current-carrying capacity for machine tool or switchboard termination. Available in 125-amp and 250-amp models. All are supplied with marking strip or are printed to order. Three-circuit models are standard. **Marathon Special Products Corp, 12th and Cranberry Sts, Erie, Penna.**

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NEW LITERATURE

Frontiers in Science

EDWARD HUTCHINGS JR. *Published by Basic Books Inc, 59 Fourth Ave, New York 3. 6 x 9, 362 pp. $6.*

Only about six human life spans, or 16 generations–a negligible fraction in the duration of human existence–separates Copernicus from Einstein. But in this short interval sciences have evolved that are almost beyond the belief of the originators themselves.

Modern science is beginning to reveal the beauty of the universe in a way that makes most poetry appear drab. No scientists can claim to understand fully any portion of the workings of our cosmos. Some say that a real understanding of the "how" of things may well be like infinity–something that can be approached but never attained. But in spite of limitations we have learned much during the last 16 generations. The search for knowledge has always appealed to the inquisitive–but it has now become an adventure–a hint of which is given in this book.

Here, in the language of the adventurers themselves, are fascinating stories of conquest, of battles now being fought on various sectors of the advancing front of science. There are 35 articles in all by such well-known scientists as Linus Pauling, J Robert Oppenheimer, George W Beadle, Fred Hoyle, and others–covering such diversified topics as "Brain Mechanisms in Behavior," "Hoarding," "The Genetic Effects of High-energy Irradiation on Human Populations," "Hypersonic Research at Caltech," "The Size of the Universe," "Why We Laugh and Cry," "The Relation of Science and Religion," "The Place of Technology in Civilization." Although the articles obviously were not selected to form a unified whole, the unity of science is such that they do fit together in interesting ways. This book should prove of interest to the engineer who is striving to keep abreast of research in neighboring fields of science. NC

Development of Engineers

"The Development of Engineers," R E Hoppe, Minneapolis-Honeywell Regulator Co. Presented at semiannual meeting (Oct 26-29) AGMA, 1 Thomas Circle NW, Washington 5, DC.

Defines what is meant by company training of engineers; describes objectives of such an undertaking and the means of achieving them, and discusses organization of a program for training engineering supervisors.

Technology and Product Design

"Technology and Product Design," John Gray, Council of Industrial Design (England); Impact, Vol IX, No 2, 1958, Unesco, United Nations, New York.

Discusses the evolution of the engineering and industrial design professions and their places within the general framework of modern industry. Application of new materials and techniques and the problems of designing for specific functions are also covered. Examples of design work are given and the training and organization of design teams are described.

METAL PARTS DESIGN–Bulletin BG-5, 8 pp. Covers metal parts designed for low-cost production on multiple-plunger and progressive tool presses, as well as stamping and deep-drawing equipment. Parts illustrated can be furnished in copper, brass, bronze, nickel silver, iron, steel, stainless steel and aluminum. American Brass Co, Dept SBR, Waterbury 20, Conn.

Circle 1, Reader Service Card

DESIGNING IN 3-D–Catalog, about 134 pp. Contains instructions for assembling and descriptions of thousands of parts and materials used in building industrial scale models. Discusses basic concepts of scale model making, planning, construction specs with illustrated examples, parts, fasteners, adhesives and tools. Scott Industries Inc, Olean, NY.

Circle 2, Reader Service Card

Letterhead Requests Only

Manufacturers who published following literature asked that requests for copies be made on company letterheads.

FILM ON CORROSION–16mm color with sound. Running time, 19 min. Tells what causes anodes and cathodes to form on steel surfaces, how they produce electrolytic corrosion, what can be done about it. For showing, write Amercoat Corp, 4809 Firestone Blvd, South Gate, Calif.

COMMERCIAL STANDARDS FOR PLASTIC PIPE–Three recommended standards on acrylonitrile-butadiene-styrene pipe: TS-5423, TS-5424, TS-5425. Specs have been proposed by SPI for consideration by the industry. H A Bonnet, Commodity Standards Div, US Dept of Commerce, Washington 25, DC.

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Publisher's Postscript...

Machine-tool Fossils

Downy-cheeked young engineers are all told of an ancient machine shop down near the tracks where a knowing old machinist makes the most-precise, most-beautiful gears and shafts and bearings you'll ever see. If you need a special test rig or a prototype, he's the man to make it.

It's a delightful fairy tale, and I hate to disillusion any romanticists in our profession, but the old machinist isn't there anymore—by present standards he probably never was. But the machine shop is there, all right, and it has all the original equipment, too—unfortunately.

This is no exaggeration. 18% of the nation's machine tools (including presses) are over 20 years old. 60% are over 10 years old, and a higher percentage of such over-10-year-old equipment is in use today than there was only 5 years ago.

These percentages aren't guesswork, either. They are the result of a survey of 5560 metalworking plants published in a 96-page report in this week's (November 17) issue of *American Machinist*. Each plant was classified (according to its principal product) in one of 44 industries and 24 geographical areas, and its equipment might include any one of 167 types. By careful extrapolation the figures were expanded to include all American productive capacity.

Some fascinating conclusions can be drawn from this latest of a long (since 1925) series of inventories: There has been a reduction in the total number of machine tools in use in the past 5 years. (However, a separate survey indicates on the average, today's equipment is 54% more productive than equipment made only 10 years ago.) Designed-in obsolescence is absurd in an industry in which engineering progress is making regular modernization an absolute necessity.

Do look over this report. You'll probably find a copy of the Nov 17 issue of *American Machinist* in your company library or production department. If not, write Catherine Kane, Reader Service Manager, *Product Engineering*, 330 W. 42 St., New York 36, NY. Ask for a copy of the American Machinist *Inventory* and enclose $2.00. You'll have the full 96-page report by return mail.

—A. H.

74 For Your Information (personal)

Gaslight era goes modern

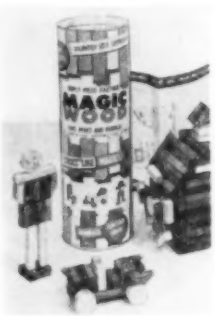
The gaslight is coming back, this time with automatic controls and the tender sponsorship of a good many utility companies. The light pictured here, for instance, was featured at the American Gas Association's recent "Parade of Progress" exhibit at Atlantic City. It is controlled by a photocell attached to a standard universal box plate and hooked up to a solenoid gas valve. According to the manufacturer, Arkla Air Conditioning Corp, the control will operate satisfactorily on light levels as low as 100 foot-candles and can be set to turn up the gas on cloudy days as well as at night. One such unit will control up to 4 lights.

Here's one for show-offs

A "radically new" semiautomatic slide projector, featuring "controlled air flow" and sporting a Marlex linear polyethylene housing, is being introduced by Optics Mfg Corp, Philadelphia.

To keep color transparencies from "popping," the projector has a special blower and air vent system said to hold operating temperature to 85.2 F or less under normal conditions. It has an aspherical condenser lens system and an F 3.5, 4-in. coated projection lens. Retail price is $49.95.

Educated blocks



An adhesive that "sticks like magic," yet poses no problems in disassembly and reuse is the novel feature of the building blocks pictured here. "Just press the blocks together," says the manufacturer, "and they'll stick until you pry them apart." They are dry to the touch, though, and won't stick to anything else. Key to the magnet-like attraction is the impregnation process used to disperse the adhesive through the wood, the manufacturer says. It's an interesting effect; might have other uses. Gem Color Co Inc, makes the blocks, distributes them nationally in $1 and $2 kits.

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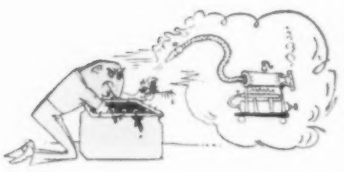
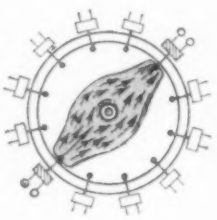


. . . a small steam cleaner? Large ones are available for steam-cleaning buildings and automobiles; a small one could be used to advantage by maintenance men. Did you ever try to clean out a greasy gear box? Rags, brushes and solvents are sloppy, and hard work. A small portable electric or gas-heated unit would be a delight. It should carry its own water supply. —C McLaughlin



. . . a magnetic, electrically conductive liquid? Used in a glass vial like a mercury switch, the device could be hermetically sealed, operated by a solenoid or a permanent magnet, and yet have no real contact or moving-part problems. The fluid also suggests other sealed-in control possibilities since it would tend to conform to the shape of the imposed magnetic field—within the limits of its container. Many contacts spaced around a disk-shaped container might be interconnected in dozens of combinations depending on the applied magnetic field. —R Myram

. . . a phone switch or dial that could be set to disconnect the ring of an incoming call and to signal the caller that the party is home but does not wish to be disturbed. The signal might also indicate how much longer the phone will be disconnected. In this way you might set your phone to leave you in peace for an hour. Any caller would hear a series of six short beeps (meaning 10 minutes each) at the start. As time passes, less time (or beeps) remain until the phone is automatically returned to normal service. —R M Averback

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